# INSTRUCTION MANUAL

For The

T-COM 235A/54B

T1 TRANSMISSION ANALYZER

With Options 01, 02, 03, 04, 05

T-COM Corporation 825 East Middlefield Road Mountain View CA 94043 (415) 964-3415

# INSTRUCTION MANUAL

For The

T-COM 235A/54B

T1 TRANSMISSION ANALYZER

With Options 01, 02, 03, 04, 05

235A S/N : 0226
HW version: 7.0 5.0
SW version: 2.9

54B S/N : _____
HW version : 2.0
SW version : 2.0

Span Power Unit S/N: _____
HW version: 2.0

Instruction Manual No.: IM 235A-07
Date isssued : August 1992

## ABOUT THIS MANUAL...

If you have never used the 235A and you would like to become thoroughly familiar with the capabilities and the operation of this instrument, we recommend that you spend some time reading this manual. Reading the first 3 chapters in particular, is highly recommended. From there on, you may just want to study the chapters of immediate interest. To derive the most benefit from the reading, we suggest that you set-up the instrument nearby and exercise it as indicated in the text.

To make this manual easier to use, its contents has been organized into a series of short chapters, each covering a single topic. These topics are itemized below.


| Topic | Chapter # |
|---|---|
| Familiarization with the 235A Capabilities | 1 |
| Front Panel Features Description | 2 |
| Initial Set-Up Procedure | 3 |
| Obtaining DS1 Transmission Statistics | 4 |
| Using the DS1 Transmit Capabilities | 5 |
| Performing Out-Of-Service Transmission Tests | 6 |
| Obtaining DS0 Channel Based Measurements | 7 |
| Using the Fractional T1 Testing Capabilities | 8 |
| Sending and Receiving ESF Datalink Messages | 9 |
| Sending and Receiving SLC-96 Datalink Messages | 10 |
| Using the Auxiliary Jacks and Connectors | 11 |
| Using the RS-232-C Interface Port | 12 |
| 235A Performance Specifications | 13 |
| Field Calibration Procedures | 14 |
| Accessories and Replaceable Parts | 15 |
| Installation Instructions | 16 |
| Warranty Information | 17 |
| Hardware & Software Version History | Appendix A |
| Span Power Unit Operating Instructions | Appendix B |

Digitized by the Internet Archive
in 2026

https://archive.org/details/manualsplus_12530

# 235A INSTRUCTION MANUAL

## TABLE OF CONTENTS


| Description | | | Page |
|---|---|---|---|
| 1. | 235A Capabilities Overview | | 1-1 |
| | 1.1 | - Introduction | 1-1 |
| | 1.2 | - Overview of the 235A Basic Capabilities | 1-2 |
| | 1.3 | - Overview of the 235A Optional Capabilities | 1-2 |
| | 1.4 | - Applications Overview | 1-3 |
| 2. | Familiarization With The 235A Features | | 2-1 |
| | 2.1 | - Introduction | 2-1 |
| | 2.2 | - The Front Panel Features | 2-1 |
| | 2.3 | - Left Side Panel Features | 2-8 |
| | 2.4 | - Right Side Panel Features | 2-8 |
| 3. | Getting Started | | 3-1 |
| | 3.1 | - Introduction | 3-1 |
| | 3.2 | - How to Set-Up and Initialize the Instrument | 3-1 |
| | 3.3 | - Description of the Self-Diagnostics Capability | 3-2 |
| | 3.4 | - System-Level Keys/Menus Operation | 3-2 |
| 4. | DS1 Monitoring & Performance Analysis | | 4-1 |
| | 4.1 | - Introduction | 4-1 |
| | 4.2 | - Real-Time DS1 Transmission Monitoring | 4-1 |
| | 4.3 | - How to Select the Proper PCM Input Mode | 4-1 |
| | 4.4 | - Performing Real-Time PCM Transmission Monitoring | 4-2 |
| | 4.5 | - Summary of Performance Measurement Definitions | 4-9 |
| | 4.6 | - In-Service Monitoring Application Information | 4-11 |
| 5. | Using The DS1 Transmit Capabilities | | 5-1 |
| | 5.1 | - Introduction | 5-1 |
| | 5.2 | - Generating DS1 Test Patterns | 5-1 |
| | 5.3 | - Sending Yellow Alarm | 5-9 |
| | 5.4 | - Simulating Errors | 5-9 |
| | 5.5 | - Generating Loop Codes | 5-11 |
| | 5.6 | - Loop Mode Operation | 5-11 |
| 6. | Out-Of-Service Testing | | 6-1 |
| | 6.1 | - Introduction | 6-1 |
| | 6.2 | - Out-Of-Service Testing Principals | 6-1 |
| | 6.3 | - Out-Of-Service Testing Capabilities | 6-4 |
| | 6.4 | - Program Test Capabilities | 6-5 |
| | 6.5 | - 235A Set-Up for Out-Of-Service Testing | 6-7 |
| | 6.6 | - General Out-Of-Service Testing Procedures | 6-8 |
| 7. | DS0 Channel Based Measurements | | 7-1 |
| | 7.1 | - Introduction | 7-1 |
| | 7.2 | - Front Panel Description | 7-1 |
| | 7.3 | - Setting-Up the 54B | 7-2 |
| | 7.4 | - DS0 Channel Content Measurement | 7-3 |
| | 7.5 | - DS0 Channel Based Measurements | 7-3 |

**Description** **Page**


7. DS0 Channel Based Measurements *(continued)*
   - 7.6 - DS0 Channel VF Measurement Application Information ..... 7-7
   - 7.7 - DS0 Supervision Monitoring Application Information ..... 7-8

8. Fractional T1 Testing ..... 8-1
   - 8.1 - Introduction ..... 8-1
   - 8.2 - Fractional T1 Testing ..... 8-1

9. Sending & Receiving ESF Datalink Messages ..... 9-1
   - 9.1 - Introduction ..... 9-1
   - 9.2 - ESF Data Link Background information ..... 9-1
   - 9.3 - ESF Data Link Monitoring, Processing and Sending Capabilities ..... 9-3
   - 9.4 - Monitoring ESF Data Link Messages ..... 9-3
   - 9.5 - Printing ESF Data Link Messages ..... 9-13
   - 9.6 - Sending ESF Data Link Messages ..... 9-20

10. Sending & Receiving SLC-96 Datalink Messages ..... 10-1
   - 10.1 - Introduction ..... 10-1
   - 10.2 - SLC-96™ Data Link Background Information ..... 10-1
   - 10.3 - Data Link Message Monitoring ..... 10-2
   - 10.4 - Monitoring SLC-96™ Data Link Messages ..... 10-2
   - 10.5 - Printing SLC-96™ Data Link Messages ..... 10-6
   - 10.6 - Data Link Message Transmission ..... 10-8

11. Auxiliary Jacks and Connectors
   - 11.1 - Introduction ..... 11-1
   - 11.2 - RS-232-C Port (J14) ..... 11-1
   - 11.3 - Aux DS1 Out Jack (J11) ..... 11-2
   - 11.4 - Aux DS1 In Jack (J13) ..... 11-2
   - 11.5 - Span Power Feed (J12) ..... 11-2
   - 11.6 - Using the 235A as CSU ..... 11-2

12. Printer Interface Port (Option 02) ..... 12-1
   - 12.1 - Introduction ..... 12-1
   - 12.2 - RS-232-C Interface Capabilities ..... 12-1
   - 12.3 - Using the RS-232-C Interface Port ..... 12-7

13. Performance Specifications ..... 13-1
   - 13.1 - Introduction ..... 13-1
   - 13.2 - System Format Compatibility ..... 13-1
   - 13.3 - DS1 Reference Section ..... 13-1
   - 13.4 - DS1 Receive Diagnostics Section ..... 13-1
   - 13.5 - DS1 Transmit Section Pattern ..... 13-1
   - 13.6 - Controls and Measurements Section ..... 13-2
   - 13.7 - Miscellaneous ..... 13-2
   - 13.8 - 54B Add-On Unit ..... 13-3

14. Field Maintenance And Calibration ..... 14-1
   - 14.1 - Introduction ..... 14-1
   - 14.2 - Routine Maintenance ..... 14-1
   - 14.3 - Calibration Overview ..... 14-1
   - 14.4 - Required Equipment ..... 14-2

Description Page

14. Field Maintenance And Calibration *(continued)*
14.5 - Accessing the Adjustments....14-3
14.6 - Calibration....14-5
14.7 - Final steps....14-10

15. Accessories And Replaceable Parts....15-1

16. Installation....16-1
16.1 - Introduction....16-1
16.2 - Initial Inspection....16-1
16.3 - Field Installation of Options....16-1
16.4 - Repacking for Shipment....16-7

17. Product Warranty....17-1

Appendix A
Hardware & Software History....A-1

Appendix B
Span Powering Unit Operation P/N 2454-006....B-1
B-1 Introduction....B-1
B-2 General Description....B-2
B-3 Features Description....B-2
B-4 Safety Considerations....B-5
B-5 Using The Span Power Unit....B-6
B-6 SPU Interface Circuit Diagram....B-7
B-7 SPU Specifications....B-9

Tables

2-1 DS1 REF Section Features....2-2
2-2 DS1 RECEIVE Section Features....2-2
2-3 DS1 TRANSMIT Section Features....2-5
2-4 Controls & Measurements Section Features....2-6
2-5 Right Hand Side Panel Features....2-9
3-1 S2 Selection Listing....3-2
4-1 Measurement Definitions, Ranges and Criteria....4-9
5-1 Hexadecimal/ Binary Conversion....5-6
6-1 Commonly used PRBS Patterns....6-3
7-1 Identified DDS Test Codes....7-4
7-2 Channel Unit Signaling State Assignments....7-9
7-3 Channel Unit Signaling State Assignments....7-10
9-1 Priority (BOM) Messages....9-8
9-2 Command/Response (BOM) Messages....9-9
9-3 Displayed Request Messages....9-10
9-4 Displayed AT&T Response Messages....9-11
10-1 Protection Line Switch Messages....10-3
10-2 Maintenance Messages Sent by the RT....10-3
10-3 Maintenance Messages Sent to the RT....10-3
10-4 Alarm Messages for COT-RT-13, COT-RT-16, and SLIM....10-4
10-5 Concentrator Status Messages Sent by the RT....10-5
10-6 Concentrator Status Messages Sent to the RT....10-6

Description Page

Tables


11-1 J14 Connector Pin Assignments ..... 11-1
12-1 Flow Control Selection ..... 12-1
12-2 Sample Activity Report ..... 12-5
12-3 Sample Activity Summary Report ..... 12-6
12-4 Receiver Status Report ..... 12-7
14-1 Calibration Tools & Test Equipment ..... 14-2
16-1 235A Option Identification ..... 16-1
B-1 Front Panel Features ..... B-2
B-2 Left Side Panel Features ..... B-3
B-3 Near Side Side Panel Feature ..... B-4
B-4 Right Hand Side Panel Features ..... B-4


Figures


1-1 235A Front Panel ..... 1-1
2-1 235A Front Panel ..... 2-1
2-2 DS1 Receiver Section Features ..... 2-2
2-3 DS1 Transmit Section Features ..... 2-4
2-4 Control & Measurement Section Features ..... 2-6
2-5 Left Side Panel Features ..... 2-8
2-6 Right Side Panel Features ..... 2-9
4-1 Minimum Required Test Time ..... 4-13
6-1 Straight Away Test Configuration ..... 6-2
6-2 Looped Test Configuration ..... 6-3
7-1 54B DS0 Channel Access Front Panel ..... 7-1
7-2 Transmit Half-Channel Gain Alignment ..... 7-6
8-1 55A DS-1C Monitor & Demultiplexer Front Panel ..... 8-1
9-1 Sample of an Activity Report ..... 9-14
9-2 Example of an ANSI Summary Report ..... 9-15
9-3 AT&T 1-Hour Performance Request and Report ..... 9-16
9-4 AT&T Enhanced 1-Hour Performance Report ..... 9-17
9-5 AT&T Enhanced 24-hour ES Performance Report ..... 9-18
9-6 AT&T Enhanced 24-hour CSS Performance Report ..... 9-19
11-1 235A CSU Configuration ..... 11-3
12-1 Null Modem Adapter/Cable ..... 12-8
14-1 Top Cover Removal ..... 14-3
14-2 Add-on Module Removal ..... 14-4
14-3 Battery Module Removal ..... 14-5
14-4 Bottom Cover Removal ..... 14-6
14-5 Calibration Access Points ..... 14-7
14-6 Receiver Board Access Points ..... 14-8
14-7 Span Current Measurement Calibration ..... 14-10
16-1 Feet & Battery Connector Plate Removal ..... 16-2
16-2 Battery Powering Option Installation ..... 16-3
16-3 Top Cover Removal ..... 16-4
16-4 Option 03 Installation ..... 16-5
16-5 Add-on Module Installation ..... 16-6
B-1 Span Powering Unit Front Panel ..... B-1
B-2 Left Hand Side View ..... B-3

Description Page

Figures

B-3 Near Side Panel View ..... B-4
B-4 Right Hand Side Panel View ..... B-4
B-5 Span Power Unit Set-Up ..... B-6
B-6 SPU To Span Line Interface Circuit Diagram ..... B-8

# CHAPTER 1
## 235A CAPABILITIES OVERVIEW

### 1.1 INTRODUCTION

The 235A is an extremely versatile instrument. It has been designed to address a wide range of test requirements related to PCM based communication systems and transmission. In brief, the instrument can be used for qualifying almost any new digital communication system and maintaining it over its operational life.

The purpose of this chapter is to help the reader develop a degree of familiarity with the instrument's capabilities. To this end, this chapter is divided into three sections:

-Basic instrument capabilities
-235A optional capabilities
-235A applications overview

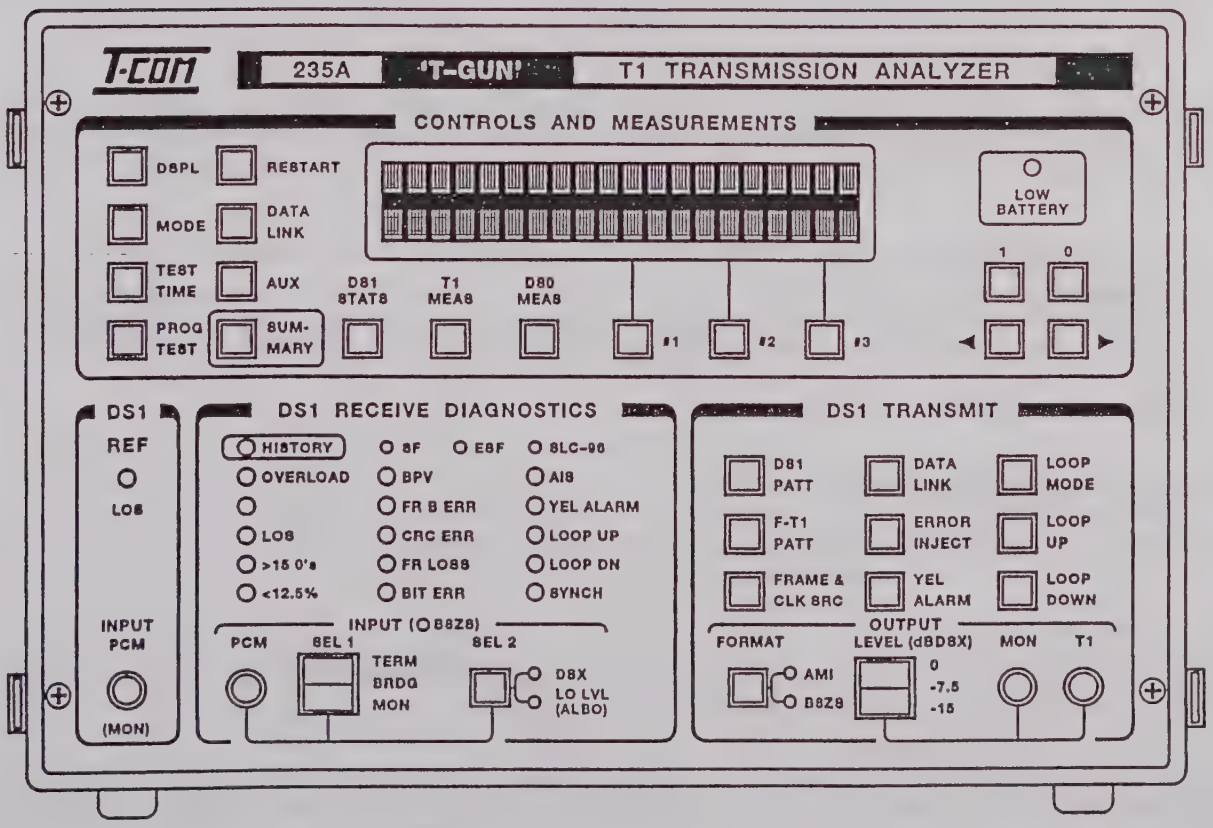



Figure 1-1 The 235A Front Panel

## 1.2 BASIC INSTRUMENT CAPABILITIES

The 235A consists of a set of two DS1 receivers, one DS1 transmitter, and a powerful measurement data processor.

These sub-systems can operate either independently of each other to perform simple tests, or in concert to perform more complex ones. The controls and indicators of each of these subsystems are conveniently arranged in separate sections of the front panel as illustrated by Figure 1-1.

The two receivers are a DS1 reference receiver and a DS1 diagnostics receiver. The reference receiver is used to supply a reference clock to the bit-by-bit slippage detector. The capabilities of the diagnostics receiver include:

- automatic recognition of SF, ESF and SLC-96 framing formats
- automatic recognition of standard test bit sequences
- recognition of loop up and down codes and automatically looping the receiver output to the transmitter input
- real-time display of PCM transmission impairments
- real-time display of PCM messages

The DS1 transmitter primarily delivers patterns used in out-of-service testing. In particular, this transmitter can generate any number of loop patterns as well as a number of stress patterns such as 3/24, 1/8 and QRS. It can also inject a variety of errors at specified rates into its output stream and, when in loop mode, provide a copy of the receiver's input.

The measurement data processor collects and processes the DS1 transmission data from the diagnostic receiver. Upon user request, the processed data is displayed by the vacuum fluorescent display tube (VFDT) in a readily usable form. The measurement capabilities provided by the basic instrument include:

- in-service transmission statistics for the diagnostics receiver (error counts, errored seconds and error rates)
- DS1 input level and frequency measurements
- slippage of the diagnostics receiver input signal with respect to the reference receiver input signal
- span line current measurements

## 1.3 235A OPTIONAL CAPABILITIES

The capabilities of the 235A can be extended by the following options:

**Option 01, Battery Powering**
A rechargeable NiCad battery pack can be secured to the bottom of the 235A to provide up to 5 hours of portable service. The battery pack is automatically recharged when the 235A is powered by the AC line. The battery pack can be installed in the field.

**Option 02, RS-232-C Printer Interface Port**
This option provides an RS-232-C interface port suitable for connecting a printer or a modem to the 235A. When a printer is connected either locally to the 235A or via a modem, a record of the time and date stamped impairment activity is automatically printed out. This option must be factory installed.

**Option 03A, Fractional T1 and Long User Pattern**
When equipped with option 03A, the 235A supports Fractional T1 testing, and various preprogrammed and user defined long user patterns can be sent and analyzed.

**Option 03B, ESF Data Link Capabilities**
When equipped with option 03B, the 235A can send and receive/decode messages carried by the ESF data link. Both the ANSI and AT&T protocols are supported.

**Option 03C, SLC-96 Data Link Capabilities**
When equipped with option 03C, the 235A can send and receive/decode messages carried by the SLC-96 data link.

**Option 04, Span Powering**
The Span Powering option is a current regulator which operates off the AC line. While powering the span line under test, it provides insulated access to the 235A. This unit provides three selectable regulated currents for different line load conditions. The span power option is housed in the removable front cover of the 235A.

**Option 05, Programmed Tests**
When the 235A is equipped with this option, the test set offers two programmed test pattern selections: the bridge-tap test and the repeater test. The bridge-tap test consists of a sequence of patterns chosen for identifying the presence of bridge taps on a T1 facility. The repeater test consists of a sequence of patterns selected to stress line repeaters. Both tests can be performed either straight away with a 235A (or similar instrument) at the far end, or with the facility looped at the far end. These tests can be run either one time or continuously for a selected time period. This option must be factory installed.

**Add-on Module 54B, DS0 Channel Access with 24-Channel Signaling**
With this module, you can select one of the 24 DS0 channels, listen to its content, display the associated signaling states, measure the frequency and level of the signal or noise, display the average bit density, and identify several test codes used in DDS testing. You can also simultaneously display signaling states for all 24 channels. The 54B add-on module mounts on top of the 235A and adds 1-1/2 inches to its height. It is field installable.

> **Note**
> All options can be combined as required. Field installation instructions are found in Chapter 16.

## 1.4 APPLICATIONS OVERVIEW

The 235A is designed to be used either in the central office or a communication center, or out on the T1 line to qualify newly installed digital communication systems. The 235A can be used to help craft personnel maintain and troubleshoot this equipment. The 235A applications can thus be divided into out-of-service testing applications and in-service testing applications.

### 1.4.1 Out-of-Service Testing Applications

The two main applications areas are PCM transmission facility testing and equipment functional check, or acceptance testing. The 235A allows you not only to loop a line, but to send a variety of test patterns to stress the facility and to obtain a comprehensive performance evaluation at the same time. The programmed test capability (option 05) automates the process of PCM transmission testing, yielding fast, and repeatable tests.

The 235A can also be used to test a variety of DS1/T1 based equipment to validate their functionality prior to placement into service, and ensure their conformity with the specifications.

Typically, the 235A transmitter is used as a PCM signal source while the DS1 receiver monitors and analyzes the bit stream delivered by the equipment under test. Specifically, the applications of the 235A in this mode include the testing of many DS1 transmission parameters for PCM channel banks, multiplexers (M1C and M13), transmultiplexers, echo cancellers, etc.

### 1.4.2 In-service Testing Applications

The 235A is particularly well suited to perform non-disruptive transmission performance testing. To this end, the 235A can be configured to perform passive monitoring of a DS1/T1 circuit. The 235A can be bridged across the line, connected in series with it or configured as a CSU. With the 54B add-on module the 235A can also passively monitor DS0 channels.

The bulk of this instruction manual provides detailed information on all the areas touched in this chapter.

Happy reading.

# CHAPTER 2
# FAMILIARIZATION WITH THE 235A FEATURES

## 2.1 INTRODUCTION

This chapter describes the functions of the 235A 'T-GUN' front and side panel components: switches, indicators, connectors, etc. In the process, some software based features are described. A detailed description of the software based features is provides in Chapters 3 through 11. We strongly recommend that you study the descriptions in this chapter and operate the switches on your unit before using it for actual testing.

## 2.2 FRONT PANEL FEATURES

The T-GUN front panel is shown in Figure 2.1. Although it may appear at first glance to be fairly complicated, its use becomes quickly intuitive as you recognize the grouping of its features in the four functional areas: CONTROLS AND MEASUREMENTS, DS1 REF, DS1 RECEIVE DIAGNOSTICS, and DS1 TRANSMIT.

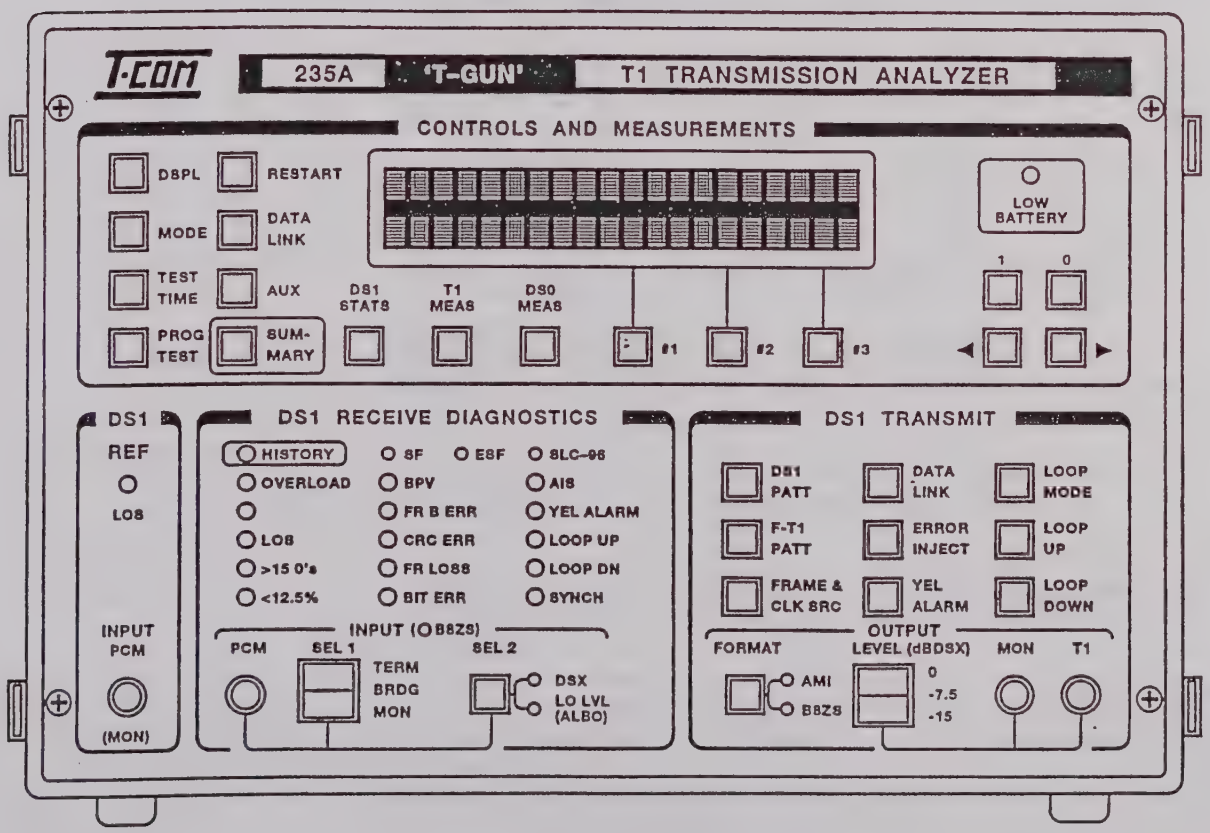



Figure 2.1 235A Front Panel

The DS1 REF section accepts a T1 reference bit stream. This stream is needed when measuring bit slippage between this reference signal and the T1 bit stream applied to the DS1 RECEIVE DIAGNOSTIC section. The DS1 TRANSMIT section controls allow you to select several parameters of the DS1 signal delivered by this section. The CONTROLS AND MEASUREMENTS section is primarily used for setting-up the test set and to make quantitative measurements on the PCM signal applied to the DS1 RECEIVE DIAGNOSTICS section. Chapter 1, Capabilities Overview, describes the functions and applications of the four sections in more detail.

The function of each of the keys and LEDs in the four front panel sections are described in Tables 2.1, 2.2, 2.3 and 2.4. The item numbers in these tables correspond to the circled numbers in the referenced figures.

### 2.2.1 DS1 REF section. Refer to Figure 2.2

| Item | Name | Operation/Description |
|---|---|---|
| 1 | LOS | Is lit when the bit stream at the INPUT PCM jack (Item 2) consists of a string of over 175 +/- 25 consecutive zeros. |
| 2 | INPUT PCM | Accepts PCM signals from a DSX-1 monitor jack. |

Table 2.1 DS1 REF Section Features

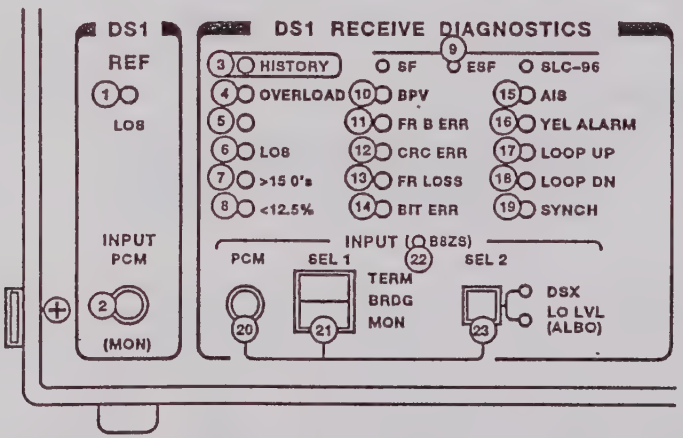



Figure 2.2 DS1 REF and RECEIVE DIAGNOSTICS Sections Features

### 2.2.2 DS1 RECEIVE DIAGNOSTICS section. Refer to Figure 2.2

| Item | Name | Operation/Description |
|---|---|---|
| 3 | HISTORY | Flashes ON/OFF when a transmission impairment has been detected. Is cleared by depressing the RESTART key or softkey #3 and SUMMARY at the same time. |

*Part of Table 2.2* *(Continued)*

| Item | Name | Operation/Description |
|---|---|---|
| 4 | OVERLOAD | Is lit when the amplitude of the signal at the INPUT PCM jack (Item 20) exceeds the selected level range by 3 dB. |
| 5 | - | Reserved for future use. |
| 6 | LOS | Is lit when the monitored bit stream contains a string of over 175 +/- 25 consecutive zeros. |
| 7 | > 15 0's | Is lit when the monitored bit stream contains a string of over 15 consecutive zeros. When the configuration DIP switch position 3 is set OFF, the LED is disabled if the DS1 pattern is recognized by the receiver. |
| 8 | < 12.5% | Flashes ON when the ones density in the monitored bit stream contains fewer than 3 ones in 24 times slots. When the configuration DIP switch position 3, on the right side of the box, is set OFF, the LED is disabled if the DS1 stream is recognized by the receiver. |
| 9 | SF/ESF/SLC-96 | Indicates the framing format of the PCM bit stream at the INPUT PCM jack (Item 20). |
| 10 | BPV | Flashes ON when the monitored PCM bit stream contains two consecutive one bits with the same polarity not part of a B8ZS code. |
| 11 | FR B ERR | Flashes ON when the monitored PCM bit stream contains a (Ft) frame bit error. |
| 12 | CRC ERR | Flashes ON when the monitored bit stream contains a CRC error (ESF format only). |
| 13 | FR LOSS | Is lit when the monitored bit stream is unframed or when framing is lost. This occurs when two frame bits out of five are in error. |
| 14 | BIT ERR | Flashes ON when the monitored bit stream contains a bit error. This can occur only when the SYNCH LED is lit. |
| 15 | AIS | Is lit when the monitored bit stream consists of an uninterrupted sequence of one bits for at least 40 ms. If the DIP switch position 4 is set to ON, this LED is enabled when the all-ones sequence is framed. |
| 16 | YEL ALARM | Is lit when the monitored bit stream contains the yellow alarm code. This code may be carried in band (SF) or out-of-band (ESF). |
| 17 | LOOP UP | Is lit when the monitored bit stream contains a loop up code found in the TRANSMIT section loop up code vocabulary. |

*Part of Table 2.2* *(Continued)*

| Item | Name | Operation/Description |
|---|---|---|
| 18 | LOOP DN | Is lit when the monitored bit stream contains a loop down code found in the TRANSMIT section loop down code vocabulary. |
| 19 | SYNCH | Is lit when the monitored bit stream contains a recognized bit sequence or test pattern. Is turned OFF when the receiver loses synchronization as a result of excessively high error rates. |
| 20 | INPUT PCM | Accepts the T1/DS1 formatted bit streams to be monitored by the DS1 RECEIVE DIAGNOSTICS section. |
| 21 | INPUT SEL 1<br>- TERM<br>- BRDG<br>- MON | Configures the PCM input circuit to provide:<br>: 100 Ohms, for DSX level<br>: 1000 Ohms, for DSX level<br>: 100 Ohms, for signals supplied by monitor jacks. |
| 22 | INPUT B8ZS | Is lit for one second when the B8ZS code is detected in the monitored bit stream. |
| 23 | INPUT SEL 2 | Configures the PCM input circuit to accept:<br>- DSX : bit streams from DSX jacks<br>- LO LVL: bit stream at the input of a repeater (DSX level attenuated by 6 to 34 dB)<br>The LO LVL selection is not compatible with the MON selection of the SEL 1 switch. |

Table 2.2 DS1 RECEIVE Section Features

2.2.3 DS1 TRANSMIT section. Refer to Figure 2.3

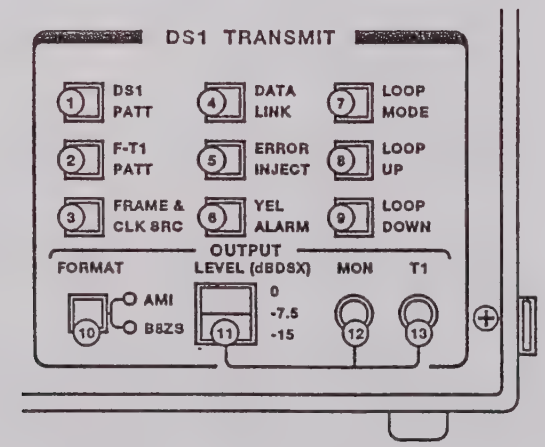



Figure 2.3 DS1 TRANSMIT Section Features

| Item | Name | Operation/Description |
|---|---|---|
| 1 | DS1 PATT | Accesses the menu of bit patterns that can be delivered by the transmit section. The LED in this key flashes on and off while the VFDT displays the menu. The LED is solidly lit when the generated bit stream is selected from this menu or when it is a copy of the DS1 signal presented to the AUX DS1 INPUT (jack on the right hand side of the instrument). |
| 2 | F-T1 PATT | Accesses the menu of fractional T1 bit patterns that can be delivered by the transmit section. The 235A must be equipped with option 03A to support this capability. |
| 3 | FRAME & CLK SRC | Enables you to select the DS1 framing mode as well as the clock source of the delivered T1 stream. |
| 4 | DATA LINK | Accesses the menu of data link messages that can be delivered by the transmit section. The 235A must be equipped with option 03B to support the ESF data link capability; option 03C is required to support the SLC-96 data link capability. |
| 5 | ERROR INJECT | Accesses the transmission impairment injection menu. This menu allows the selection of several error types over a wide range of rates. Some selections may be blanked out from the menu when they would be incompatible with current pattern selections. |
| 6 | YEL ALARM | Enables you to send the yellow alarm in the outgoing T1 bit stream. The alarm is sent while the LED in this key is lit. |
| 7 | LOOP MODE | This mode prevails when the LED in the key is lit. At this time, the transmit section delivers a copy of the PCM bit stream monitored by the DS1 RECEIVE DIAGNOSTICS section. This mode is exited by depressing either the DS1 PATT or the F-T1 keys. |
| 8 | LOOP UP | Accesses the LOOP UP menu unless the LOOP MODE is selected. The loop-up menu allows you to select several (in-band) loop-up codes. |
| 9 | LOOP DN | Accesses the LOOP DN menu unless the LOOP MODE is selected. The loop-down menu allows you to select several (in-band) loop-down codes. |
| 10 | OUTPUT FORMAT | The AMI and B8ZS LEDs associated with the key indicate the format of the T1 bit stream. When the B8ZS format is selected, any sequence of 8 consecutive zeros is replaced by the B8ZS code. |
| 11 | OUTPUT LEVEL | Selects the level of the T1 bit stream. The setting should be 0 when nominal DSX level is required. The -7.5 dB and -15 dB selections simulate 7.5 and 15 dB of PIC cable loss. |

*Part of Table 2.3* *(Continued)*

| Item | Name | Operation/Description |
|---|---|---|
| 12 | OUTPUT MON | Supplies a copy of the bit stream delivered by the T1 jack (Item 13) through a set of two 430 Ohm resistors. When terminated by a 100 Ohm resistor, the level at this jack is nominally 20 dB below the level at the T1 jack. |
| 13 | OUTPUT T1 | Supplies the T1 bit stream delivered by the transmission section. |

Table 2.3 DS1 TRANSMIT Section Features

## 2.2.4 CONTROLS AND MEASUREMENTS section. Refer to Figure 2.4

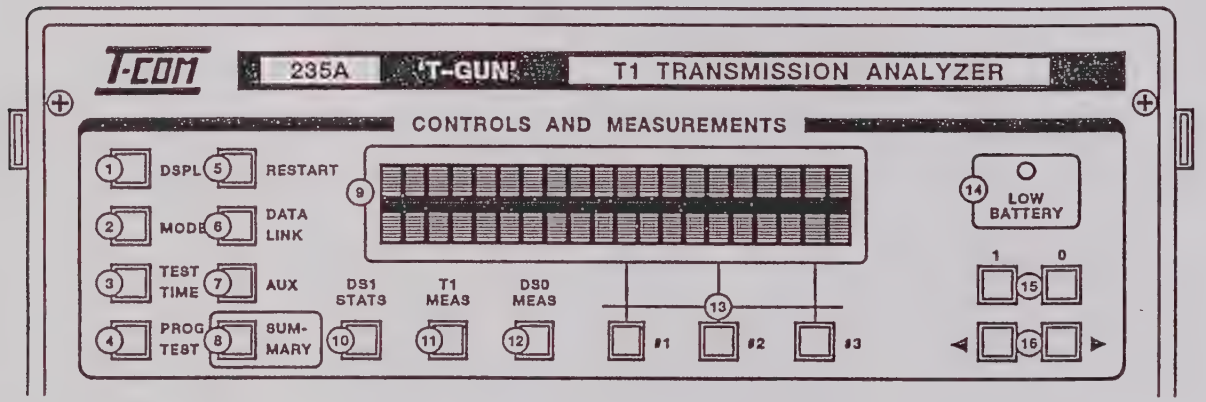



Figure 2.4 CONTROLS and MEASUREMENTS Section Features

| Item | Name | Operation/Description |
|---|---|---|
| 1 | DSPL | Controls the VFDT brightness. Three settings can be selected to adapt to various lighting conditions. |
| 2 | MODE | Accesses the MODE menu. This menu lets you:<br>- initialize the real time clock and calendar<br>- view the software version<br>- view the DIP switch selections<br>- select the RS-232-C port parameters<br>- enter printer/downloading related commands<br>Additional information is found in Chapter 3. |

*Part of Table 2.4* *(Continued)*

| Item | Name | Operation/Description |
|---|---|---|
| 3 | TEST TIME | This menu allows you to set the duration of a test. It also supplies the elapsed time since the instrument was last initialized (RESTART). |
| 4 | PROG TEST | When the 235A is equipped with option 05, this menu offers a selection of two pre-programmed test sequences. These sequences are used to speed-up the qualification of repeatered lines and to identify whether bridge taps exist on the line. |
| 5 | RESTART | Depressing this key causes all the impairment event counters and the test timer to be reinitialized. The HISTORY LED in the DS1 RECEIVE DIAGNOSTICS section is also cleared upon depressing this key. |
| 6 | DATA LINK | When the 235A is equipped with either option 03B or 03C, this key accesses the data link message display menu. Refer to Chapter 9 for information about ESF data link messaging and to Chapter 10 for SLC-96 data link messaging. |
| 7 | AUX | Reserved for future use. |
| 8 | SUMMARY | While held depressed, this key causes the LEDs in the DS1 RECEIVE DIAGNOSTICS section to indicate whether the corresponding impairment occurred since the last RESTART. The SUMMARY menu also displays the impairment event counts recorded since the beginning of the test period. |
| 9 | VFDT | The 2 line by 20 character vacuum fluorescent display tube. |
| 10 | DS1 STATS | This menu provides a complete impairment statistics of the activity since last RESTART. |
| 11 | T1 MEAS | This menu yields the bit slippage display, the level and the clock frequency measurement of the bit stream monitored by the DS1 RECEIVE DIAGNOSTICS section. It can also give the measurement of the span line DC current when the test set is patched in series with the span line. |
| 12 | DS0 MEAS | When a 54B DS0 CHANNEL MONITOR is added to the 235A, this key accesses the menu of DS0 measurements. |
| 13 | #1/#2/#3 | The function served by each key changes from screen to screen. A header on the screen bottom line identifies the function when one is assigned. |
| 14 | LOW BATTERY | Flashes when the charge of the optional external battery is nearly depleted. If the set is not powered by the AC line at this point, only about 15 minutes of operation remain before the set shuts itself down. |

*Part of Table 2.4* *(Continued)*

| Item | Name | Operation/Description |
|---|---|---|
| 15 | 1/0 | User-programmable codes are entered using these two keys. |
| 16 | < / > | These two pointer keys moves the cursor to the ieft and to the right side of the screen respectively. |

Table 2.4 CONTROLS AND MEASUREMENTS Section Features

## 2.3 LEFT HAND SIDE PANEL FEATURES

A view of the T-GUN left hand side panel is shown in Figure 2.5. This figure shows the ON/OFF power switch, the AC power inlet and the AC line fuse.

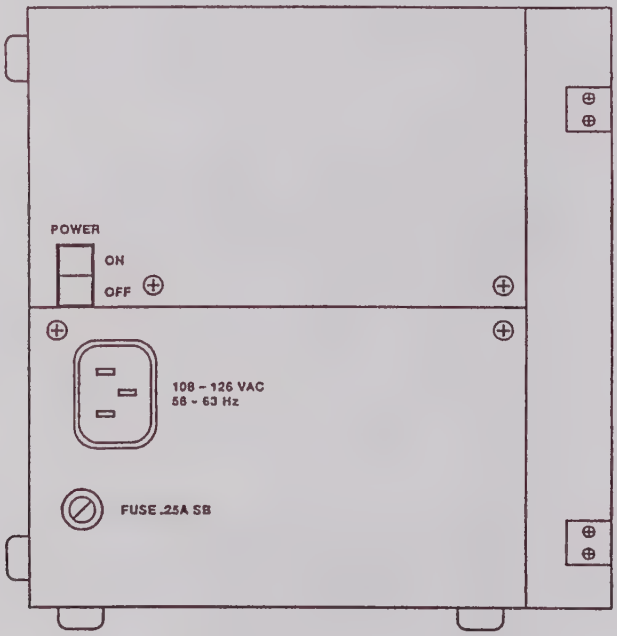



Figure 2.5 Left Hand Side Panel View

## 2.4 RIGHT HAND SIDE PANEL FEATURES

A view of the T-GUN right hand side panel is shown in Figure 2.6. A functional description of the features on this panel is given in Table 2.5

| Item | Name | Operation/Description |
|---|---|---|
| 1 | RS-232-C | This 25 pin connector is used primarily to attach a printer to the instrument to obtain a hard copy of transmission impairment statistics and data link messages. This port is active only if the 235A is equipped with option 02. Additional information about this port is found in Chapters 9, 10, and 11. |
| 2 | J12 | This 9 pin connector was originally intended for connecting the span power unit. Because the span power unit must now be patched directly to the 235A PCM INPUT and OUTPUT jacks, this connector is not used at this time. |
| 3 | S2 FACTORY SETTING | This decal illustrates the factory setting for the configuration DIP switch S2 (Item 6). |
| 4 | AUX DS1 OUT | This jack delivers nominally a zero dBDSX copy of the bit stream monitored by the DS1 RECEIVE DIAGNOSTICS section. |
| 5 | AUX DS1 IN | This jack accepts a zero dBDSX bit stream. When such a signal is applied, the DS1 TRANSMIT section delivers a copy of this signal in lieu of the internally generated one. |
| 6 | S2 | This DIP switch is use for configuring the 235A. Refer to Chapter 3 of this manual for instructions. |

Table 2.5 Right Hand Side Panel Features

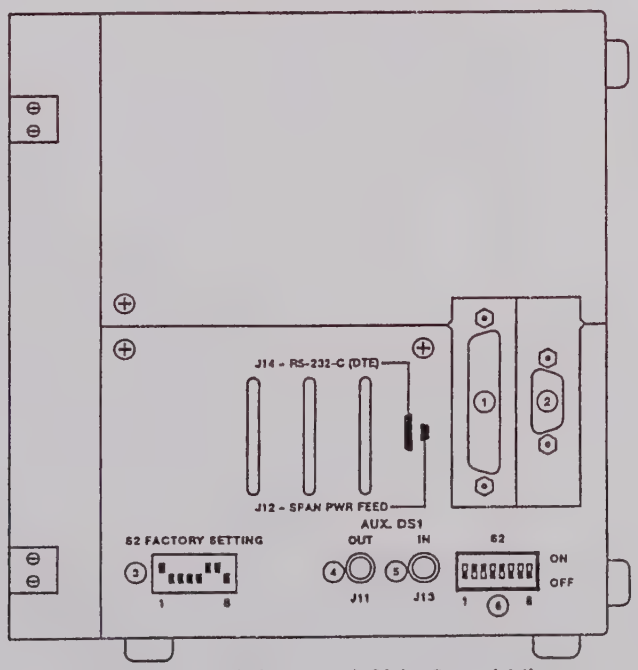



Figure 2.6 Right Hand Side Panel View

# CHAPTER 3
# GETTING STARTED

## 3.1 INTRODUCTION

This chapter contains important information about setting up and preparing the 235A for use. Additionally, this chapter describes the self-diagnostics procedure and the operation of the four system-level keys in the Control and Measurements section.

## 3.2 SETTING-UP AND INITIALIZING THE 235A

### - Physical Considerations

Because the 235A does not contain any position sensitive components, it can be operated in any position. Typically, it is placed either vertically on the floor resting on its rear panel feet, or horizontally lying on a cart or shelf.

To ensure effective convection cooling, the 235A must not be operated while in its canvas carrying case.

> **CAUTION**
>
> **If the 235A is exposed to excessive humidity the application of power can be dangerous to the instrument and to the personnel using the set.**

### - AC Powering Considerations

To power the 235A from the AC line, the female connector of the AC power cord supplied with the instrument must be plugged into the left side panel AC inlet and the male plug to a power line outlet. To operate properly, the AC line voltage at the outlet must be in the range of 108 to 126 VAC. As a general rule, it is not advisable to use long extension cords as these may cause significant voltage drops and result in unsatisfactory operation of the set. The 235A is powered-up by setting the left side panel power switch to ON.

### - Powering from the Optional Battery Pack

The battery pack is secured to the bottom of the 235A. When the 235A is equipped with a battery pack, the set can be operated by setting its power switch to ON. If the battery has sufficient charge, the test set should carry out the self-check procedure. If the battery charge is nearly depleted, the LOW BATTERY LED flashes on and off. If the LED is off and the self-check does not run when the set is turned on, either the battery charge is depleted or the set is not operational.

### - Selecting Operating Modes

The operating mode selection is performed by setting the 8-position DIP switch (S2) on the right side panel as needed. Switch position 5 requires setting prior to power-up. All the other selections can be made with power on or off. The descriptions of these selections are given in the chapters listed in Table 3-1.

**Table 3-1. S2 Selection Listing**

| POSITION | ON | OFF | CHAPTER |
|---|---|---|---|
| 1 | RS-232-port flow control | | 3, 12 |
| 2 | RS-232-port flow control | | 3, 12 |
| 3 | ZEROS-ALWAYS | ZEROS-SYNC-L | 3 |
| 4 | AIS-FR or UFR | AIS-UFR only | 3 |
| 5 | RTC CAL | Normal | 14 |
| 6 | Auto-loop ON | Auto-loop OFF | 3 |
| 7 | Auto-search ON | Auto-search OFF | 3 |
| 8 | YL-AL NO PRNT | YL-AL IN PRNT | 3 |

S2/5 selects the real-time clock calibration mode. Unless calibration is to be performed, this switch must remain in the OFF setting.

## 3.3 SELF-DIAGNOSTICS CAPABILITY DESCRIPTION

Upon power-up the 235A automatically executes a comprehensive self-diagnostic routine. This routine verifies the operational integrity of the internal system. If a non-catastrophic operational difficulty is encountered, the execution of the self-diagnostic routine is suspended and a message indicating the nature of the problem is displayed by the vacuum fluorescent display tube (VFDT). At this point the user has the choice to use the set in spite of the identified problem or to take corrective action. To complete the self test sequence in the event of a non-catastrophic difficulty, you must hit the NXT softkey.

If, in the course of executing the self-diagnostics routine, no failures are detected, all elements of the VFDT are lit (if unit is not on battery power) and all front panel LEDs are turned on for a brief period. screens [1] through [3] are each then displayed for 3 seconds.

Screen [1]

```
T-COM
235A-T-GUN
```

Screen [2]

```
THE START UP TESTS
ARE COMPLETE
```

Screen [3]

```
ALL SYSTEMS ARE
GO !!
```

Screen [4]

```
RECEIVER LOS
POWER WAS LOST
```

When the 3 second time-out is over, the SUMMARY key flashed, the VFDT displays a screen similar to screen [4] and the instrument is reset. This reset causes all impairment counters to be cleared and the test timer to be set to 00:00.

## 3.4 SYSTEM-LEVEL KEY OPERATION

The four keys located on the left side of the Control and Measurements section control the operation of the entire unit. The operation of each of these keys is described on the following pages.

- DSPL

This key controls the intensity of the VFDT display. When the 235A is first turned on, the display comes on at 75% of full intensity (50% of full intensity under battery power). Depressing the DSPL key once changes the intensity to 50%; depressing the key a second time changes the intensity to 100%. Successive keying rotates the setting through 75%, 50%, 100%, and so on.

When the 235A is powered from the optional battery pack, the VFDT screen is blanked out after 1 minute if no key is depressed. The display is restored for another 1-minute period upon depressing any front-panel key on the 235A or add-on module. It should be noted that higher intensities for the VFDT require more battery power. For this reason, the VFDT powers on at 50% intensity when operating with the battery pack.

- MODE

The MODE key provides access to a menu of five useful functions:

- selecting printer related transmission parameters
- entering printer related commands
- setting the built-in clock and calendar
- viewing the settings and functions of DIP switch S2 at the right side of the 235A
- viewing the version number of the software installed in the 235A

**Note**

To avoid repetitions, the root screen is defined in this section as any screen whose top line is as shown, regardless of which header is underlined.

```
TIME  DATE SW  S2  PRNT
```

If your 235A is not equipped with option 02, screen [5] is displayed when the MODE key is momentarily depressed.

Screen [5]

```
TIME  DATE  SW  S2  PRNT
OPTION 02 REQUIRED
```

By depressing either pointer key, you may underline (select) any other header in this screen.

When your 235A is equipped with option 02, the PRNT selection in the MODE menu lets you configure the RS-232-C port and select the reports to be downloaded to the printer (or other terminals) connected to the RS-232-C port. screen [6] is the first screen in the PRNT menu.

Screen [6]

```
TIME  DATE  SW  S2  PRNT
SUM. REPORT       GO  NXT
                  #   #
```

Depressing the GO softkey in screen [6] causes the 235A to download a summary report to the printer. Pressing the NXT softkey in screen [6] causes the VFDT to display the next command screen [7].

Screen [7]

```
TIME  DATE  SW  S2  PRNT
RCVR STATUS       GO  NXT
                  #   #
```

Depressing the GO softkey in screen [7] causes the 235A to download the receiver status report to the printer. Pressing the NXT softkey causes the VFDT to display screen [8], the activity report time resolution screen.

Screen [8]

| TIME | DATE | SW | S2 | PRNT |
|---|---|---|---|---|
| REPRT TMR | | 01 | SET | NXT |
| | | | # | # |

In screen [8], the report time resolution is one minute. Any value in the range of one-to-99 minutes can be selected. The time resolution selection defines the minimum time elapsed between successive printing entries in the activity report. To clarify, consider the following examples:

Assume that over the next three minutes the impairment activity detected by the 235A is:

- 3 BPVs during the first minute,
- 0 BPVs during the second minute, and
- 2 BPVs during the third minute.

If the REPRT TMR is 01, the printed report reads:

| DATE | TIME | EVENTS | COUNTS |
|---|---|---|---|
| 3/15/92 | 15:03 | BPV | 3 |
| 3/15/92 | 15:05 | BPV | 2 |

If the REPRT TMR is 03, the printed report reads:

| | | | |
|---|---|---|---|
| 3/15/92 | 15:05 | BPV | 5 |

Screen [9]

| ACTIVITY REPORT TIMER | | UP | DN | 01 SET |
|---|---|---|---|---|
| | | # | # | # |

Once the desired value has been selected, depressing the SET softkey causes the VFDT to display screen [8] with the new value.

Depressing the NXT softkey in screen [8] causes the VFDT to display screen [10]. This screen displays the following RS-232-C port parameters:

Screen [10]

| TIME | DATE | SW | S2 | PRNT |
|---|---|---|---|---|
| 4800 7 N 2 | | | SET | NXT |
| | | | # | # |

the baud rate (4800), the number of data bits (7), the parity (none), and the number of stop bits (2).

Depressing the NXT softkey in screen [10] allows you to change the RS-232-C port parameters via a series of screens starting with screen [11].

Screen [11]

| Baud Rate: | 300 | | 1200 |
|---|---|---|---|
| 2400 | 4800 | 9600 | NXT |
| | | | # |

The first screen [11] displays the baud rate menu. The current selection is underlined. Use the left or right arrows to select the baud rate to be used with the printer. Depressing the NXT softkey in screen [11] yields screen [12].

Screen [12]

| Data Bits | 7 | 8 | |
|---|---|---|---|
| | | | NXT |
| | | | # |

This screen displays the available number of data bits per ASCII character. The current selection for the number of data bits is underlined. Use the left or right arrows to select the desired number of data bits to be used. Depressing the NXT softkey yields screen [13].

Screen [13]

```
PARITY: NONE  ODD  EVEN
                    NXT
                     #
```

This screen displays the parity selections. The current selection is underlined. Use the left or right arrows to select the desired parity. Depressing the NXT softkey causes the VFDT to display screen [14].

Screen [14]

```
Stop Bits:   1    1.5   2
                    NXT
                     #
```

The screen displays the selections for the number of stop bits in each ASCII character. The current selection is underlined. Use the left or right arrows to select the required number of stop bits. Depressing the NXT softkey causes the VFDT to display screen [10] with the newly entered parameter values.

Depressing the NXT softkey in screen [10] causes the VFDT to display one of the following screens: [15], [16], [17] or [6] as appropriate.

Screen [15]

```
TIME  DATE  Sw  S2  PRNT
BRDG-TAP RES.   GO  NXT
                #   #
```

Screen [16]

```
TIME  DATE  SW  S2  PRNT
REPEATER RES.   GO  NXT
                #   #
```

Screen [17]

```
TIME  DATE  SW  S2  PRNT
PRM DATA RPT.   GO  NXT
                #   #
```

- Screen [15] is displayed if the bridge tap test has been run.
- Screen [16] is displayed if the repeater test has been run.
- Screen [17] is displayed if option 03B is installed.
- Screen [6] is the default screen. It is displayed only when none of the conditions for displaying screens [15], [16], or [17] is met.

Depressing the GO softkey in screen [15] lets you download the bridge-tap test results to the printer. Depressing the NXT softkey causes the VFDT to display screen [16] if the repeater test has been run. If this test has not been run, the VFDT displays screen [17] if option 03B is installed or screen [6] if it is not.

Depressing the GO softkey in screen [16] lets you download the repeater test results to the printer. Depressing the NXT softkey causes the VFDT to display screen [17] if option 03B is installed, or screen [6] if it is not.

Depressing the GO softkey in screen [17] causes the 235A to download the ANSI Performance Report Message (PRM) to the printer. Depressing the NXT softkey causes the VFDT to display screen [6].

When the MODE menu root screen is displayed, shifting the underline to TIME causes the VFDT to display screen [18].

Screen [18]

```
TIME  DATE  SW  S2  PRNT
21:06:22            SET
                     #
```

To change the time, depress the SET key; this causes a screen similar to screen [19] to be displayed.

Screen [19]

```
TIME    21:06
                UP  DN  SET
                #   #   #
```

In screen [19], position the cursor under the hours or minutes digits with the left or right arrow keys and increment or decrement the selected digit with the UP or DN softkey. Set the time slightly ahead of real time and press the SET softkey when the real time equals set time. This updates the clock and returns you to screen [18].

When the MODE menu root screen is displayed, shifting the underline to DATE causes the VFDT to display screen [20].

Screen [20]

```
TIME  DATE  SW  S2  PRNT
10/01/91            SET
                    #
```

To change the date, depress the SET key; this causes a screen similar to screen [21] to be displayed.

Screen [21]

```
 Date : 10/01/91
(M/D/Y)       UP  DN  SET
              #   #   #
```

Use the UP and DN softkeys to set respectively the month, day, and year. Depressing the SET softkey causes the VFDT to display screen [20] with the new date.

When the MODE menu root screen is displayed, shifting the underline to SW causes the VFDT to display screen [22].

Screen [22]

```
TIME  DATE  SW  S2  PRNT
      Version 2.7
```

The bottom line displays the version of the software installed in your 235A.

*Note: The softkeys are not active at this point.*

When the MODE menu root screen is displayed, shifting the underline to S2 lets you access a series of screens showing the current configuration of the instrument. This configuration is set by the DIP switch S2 located on the right hand side of the instrument. The screens display the new settings as you change the DIP switch positions. The first screen [23a] shows you the settings of segments 1 and 2 of the DIP switch. These two switches select the flow control associated with the RS-232-C port. When a switch is set to OFF, it is underlined; when it is set ON, it is not underlined. The possible selections for flow control are NONE, XON/XOFF CTS, and DSR, and are shown respectively in screens [23a} through [23d] on the next page.

Screen [23a]

```
TIME  DATE   SW  S2  Prnt
/12   FL CNTL- NONE  NXT
                    #
```

Screen [23b]

```
TIME  DATE  SW  S2  PRNT
/12   FL -CNTL- XON  NXT
                     #
```

Screen [23c]

```
TIME  DATE  SW  S2  PRNT
/12   FL CNTL- CTS   NXT
                     #
```

Screen [23d]

```
TIME  DATE  SW S2  PRNT
/12  FL CNTL- DSR   NXT
                    #
```

Depressing the NXT softkey in screen [23a] causes the VFDT to display screen [24a] or [24b] depending upon the selection of S2 position 3. screen [24a] is displayed when S2/3 is ON and indicates that the >15 0's and <12.5% LEDs are functional whether pattern SYNCH prevails or not. screen [24b] is displayed when S2/3 is OFF and indicates that the >15 0's and the <12.5% LEDs are functional only when the monitored pattern is not recognized (the SYNCH LED is off).

Screen [24a]

```
TIME  DATE  SW S2  PRNT
/3  ZEROS- ALWAYS   NXT
                    #
```

Screen [24b]

```
TIME  DATE  SW S2  PRNT
/3  ZEROS- SYNC L   NXT
                    #
```

Depressing the NXT softkey in screen [24] causes the VFDT to display screen [25a] or [25b] depending upon the selection of S2 position 4.

Screen [25a]

```
TIME  DATE  SW S2  PRNT
/4  AIS-FR OR UFR   NXT
                    #
```

Screen [25a] is displayed when S2/4 is ON and indicates that the AIS LED is functional whether the monitored all ones pattern is framed or not.

Screen [25b]

```
TIME  DATE  SW S2  PRNT
/4  AIS- UFR ONLY   NXT
                    #
```

Screen [25b] is displayed when S2/4 is OFF and indicates that the AIS LED is functional only when the monitored bit stream consists of an unframed all ones pattern.

Screen [26a]

```
TIME  DATE  SW S2  PRNT
/5  NORMAL          NXT
                    #
```

Depressing the NXT softkey in screen [25] causes the VFDT to display screen [26a] or [26b] depending upon the selection of S2 position 5. screen [26a] is displayed when S2/5 is OFF and indicates that the 235A is placed in the normal operating mode.

Screen [26b]

```
TIME  DATE  SW S2  PRNT
/5  RTC CAL         NXT
                    #
```

Screen [26b] is displayed when S2/5 is ON and indicates that the instrument is placed in the calibration mode if the unit has been powered on since S2/5 was set. This mode is used only for calibrating the real time clock. Refer to Chapter 14 of this manual for field calibration information.

Depressing the NXT softkey in screen [26b] causes the VFDT to display screen [27a] or [27b] depending upon the selection of S2 position 6.

Screen [27a]

```
TIME  DATE  SW  S2  PRNT
/6  Auto-Loop     OFF  NXT
                    #
```

Screen [27a] is displayed when S2/6 is OFF and indicates that the DS1 transmitter loop mode is not controlled by the receipt of a loop code by the DS1 receiver.

Screen [27b]

```
TIME  DATE  SW  S2  PRNT
/6  Auto-Loop      ON  NXT
                    #
```

Screen [27b] is displayed when S2/6 is ON and indicates that the DS1 transmitter loop mode is controlled by the receipt of a loop code by the DS1 receiver.

Depressing the NXT softkey in screen [27b] causes the VFDT to display screen [28a] or [28b] depending upon the selection of S2 position 7.

Screen [28a]

```
TIME  DATE  SW  S2  PRNT
/7  Auto-Srch     OFF  NXT
                    #
```

Screen [28a] is displayed when S2/7 is OFF and indicates that the DS1 receiver is not configured to search for any other patterns than the one selected in the DS1 transmitter section.

Screen [28b]

```
TIME  DATE  SW  S2  PRNT
/7  Auto-Srch      ON  NXT
                    #
```

Screen [28b] is displayed when S2/7 is ON and indicates that the DS1 receiver is configured to search for any pattern in the DS1 transmitter selection (except for channelized). When S2/7 is ON, the REGEN selection is added to the DS1 pattern menu. Refer to screen [3] in Chapter 5 for details.

**NOTE**
**When auto-search is enabled, the pattern identification process is only carried out upon entry of a RESTART command.**

Depressing the NXT softkey in screen [28b] causes the VFDT to display screen [29a] if option 02 is not installed. If option 02 is installed, screens [29b] or [29c] will be displayed depending upon the selection of S2 position 8. screen [29b] is displayed when S2/8 is off and indicates that Yellow Alarm Seconds will be displayed during activity reports. (See section 12.2.2) screen [29c] is displayed when S2/8 is on. This indicates that Yellow Alarm Seconds will not be displayed during activity reports.

Screen [29a]

```
TIME  DATE  SW  S2  PRNT
/8  OPT 02 REQ      NXT
                    #
```

Screen [29b]

```
TIME  DATE  SW  S2  PRNT
/8  YL-AL IN    PRNT NXT
                    #
```

Screen [29c]

```
TIME  DATE  SW  S2  PRNT
/8  YL-AL NO    PRNT NXT
                    #
```

- **TEST TIME**

Depressing the TEST TIME key cause the VFDT to display a screen similar to screen [30]. This screen displays:

- the time elapsed since the most recent reset of the instrument and
- the programmed test period.

Screen [30]

```
000:15:00 MAX      CONT
000:00:45 ELAP'D     GO
                     #
```

In the top line of this screen, either the CONT field or the 000:15:00 MAX field. When the CONT field is underlined, the test period is unlimited. An underline beneath the 000:15:00 MAX field indicates a test time of 15 minutes. The underline is moved by using either arrow key. Screen [30] also indicates that 45 seconds have elapsed since the last RESTART was entered.

When the CONT field is underlined, the GO softkey is as shown in screen [30]. Depressing this softkey causes the 235A to be reset and the test timer to be initialized.

When the 000:15:00 MAX is underlined, the header of softkey #3 is changed to SET; this allows you to set the test time to any value in the range 000:00:00 to 999:59:59. Upon depressing the SET key, a screen similar to screen [31] replaces screen [30].

Screen [31]

```
TEST  000:01:00
TIME          UP  DN  GO
              #   #   #
```

The desired time is set by using the < , > and UP/DN keys as described for setting the clock. When the entry is completed, the test timer is started by pressing the GO softkey or, when the SET screen is not displayed, pressing the RESTART key. Pressing GO also causes the VFDT to display screen [30] with the new test time.

If the timer times out during a test, all the impairment event counters stop tallying new counts and all error rate values are frozen. This is indicated by a flashing T in the DS1 STATS screens.

The test timer will also stop when the receiver plug is removed. This is indicated by a flashing F on the DS1 stats & summary screens.

The test time is stored in battery-backed RAM when the 235A is turned off; it needs not be re-entered the next time the instrument is powered up.

- **PROG TEST**

When the 235A is equipped with option 05, this key lets you access two pre-programmed pattern sequences automating respectively the process of stressing line repeaters and of identifying the presence of bridge taps in a PCM line.

When either test is executed, the 235A DS1 transmitter delivers specific test pattern sequences for a fixed length of time. At the same time, the DS1 receiver analyzes the monitored bit stream for bit

errors and other impairments. The BRDG-TAP test sequence consists of 21 different patterns sent for 24 seconds each. The REPEATER test sequence consists of 5 different patterns each sent for 3 minutes each.

The results obtained while carrying out these tests can supply useful information about the suitability of the transmission medium for carrying PCM traffic.

Detailed information about the programmed test capability is found in Chapter 6. This chapter describes out-of-service tests performed with the 235A.

-RESTART
Depressing the RESTART key restarts the test timer after setting it to zero and clears all event counters. If the 235A is in the autosearch mode (DIP switch S2/7 is ON), depressing RESTART will also initiate a pattern search.

# CHAPTER 4
# DS1 MONITORING AND PERFORMANCE ANALYSIS

## 4.1 INTRODUCTION

In this chapter you will find:

- an overview of real-time DS1 transmission monitoring
- directions to set-up the 235A for DS1 monitoring
- a description of the real-time DS1 diagnostic capability
- a description of the DS1 impairment data measurements
- in-service monitoring application information

Before using the information in this chapter, we recommend that you study Chapter 3 thoroughly to familiarize yourself with the functions of the 235A controls and indicators.

## 4.2 REAL-TIME DS1 TRANSMISSION MONITORING

The 235A is equipped with a DS1 diagnostic receiver to provide real-time monitoring and to evaluate the transmission performance of any DS1 formatted signal as typically found at DSX-1 bays. It also contains a reference receiver allowing the 235A to display bit-by-bit slippage between two bit streams.

## 4.3 SETTING-UP THE PCM INPUT SELECTION

The DS1 Receive Diagnostic INPUT PCM jack can be configured to accept the signal found at a monitor jack, at a bridging jack or at an input or output jack. The input is configured by setting the INPUT SEL 1 and INPUT SEL 2 switches next to the INPUT PCM jack. When patching the 235A DS1 Receiver PCM INPUT jack at the DSX bay, set INPUT SEL 2 to DSX and INPUT SEL 1 as follows :

| Jack Type | Selection | Impedance (Ohms) |
|---|---|---|
| Input | TERM | 100 |
| Bridging | BRDG | 1000 |
| Monitor | MON | 100 |

When patching the 235A DS1 Receiver PCM INPUT jack across the PCM line where the level is in the range of -7 to -34 dBDSX, set INPUT SEL 2 to LO LVL and INPUT SEL 1 as follows:

| Jack Type | Selection | Impedance (Ohms) |
|---|---|---|
| Input | TERM | 100 |
| Bridging | BRDG | 1000 |

The DS1 Reference Receiver INPUT PCM jack is compatible with the signal level found at a monitor jack (-20 dBDSX nominal). It is overloaded (but not damaged) by a 0 dBDSX signal.

When the 235A is patched to a simplex powered span line, some simple precautions must be taken.

**CAUTION**

The 235A PCM access jacks are designed to be patched to circuits protected from lightning surges and exhibiting voltages not exceeding 250 volts with respect to earth ground. The application of voltages in excess of 250V can harm personnel and 235A alike.

Before patching the DS1 Receive Diagnostics INPUT PCM jack to wet circuits, it is highly recommended to ensure that the 235A is properly grounded to the AC power line via the power cord. If the power cord is frayed or is in poor condition, it should be replaced. Furthermore, to prevent shorting the line to ground, the order of patching an input to the line should be: patch to the 235A first and patch to the live circuit last.

## 4.4 PERFORMING REAL-TIME PCM TRANSMISSION MONITORING

When the 235A PCM input selection is properly set, the DS1 Diagnostic Receiver analyzes the applied PCM signal and displays its status in real time with dedicated LEDs and with the VFDT.

### 4.4.1 LED Display

The diagnostic information supplied by each LED is given below.

HISTORY LED:
- flashes on and off when a transmission impairment or an alarm message has been detected. (The occurrence of < 12.5% ones density or B8ZS does not cause the HISTORY LED to turn on.)
- is turned off when the Control and Measurements RESTART key is depressed at the start of a new test period. History may be cleared without a restart by pressing SUMMARY and the CLR softkeys simultaneously.

OVERLOAD LED:
- is steadily lit when the input PCM level equals or exceeds 3 dBDSX while the INPUT SEL 2 switch is set at DSX or when the PCM level is greater than -6 dBDSX while the INPUT SEL 2 switch is set at LO LVL.

LOS LED:
- is steadily lit when no T1 bit stream is present at the jack, or if the signal amplitude is below the minimum acceptable level or if the line is said to be oscillating.
- flashes on when 175±25 consecutive 'zeros' are detected.

>15 0's LED:
- flashes on when a string in excess of 15 consecutive 'zeros' is detected if DIP switch S2/3 is set to ON. If DIP switch S2 position 3 is set to OFF, this LED will not turn on when the SYNCH LED is lit AND one of the following patterns is received: $2^{15}$-1, $2^{20}$-1, $2^{23}$-1 or the user defined code. If DIP switch S2/3 is set to ON, this LED is lit any time a string of 16 zeros is found.

<12.5% LED:
- flashes on when less than three 'one' bits are detected in a 24-bit sliding window of the PCM stream if DIP switch S2/3 is set to ON. If DIP switch S2 position 3 is set to OFF, this LED will not turn on when the SYNCH LED is lit AND one of the following patterns is received: QRS, $2^{15}$-1, $2^{20}$-1, $2^{23}$-1, 1/8, 3/24 or the user defined code. If DIP switch S2/3 is set to ON, this LED is lit any time fewer than 3 'ones' are detected in a 24-bit window.

**SF/ESF/SLC-96 LEDS:**
- one of these LEDs is lit solid to indicate the framing format of the monitored bit stream. None of these LED's is lit when the monitored bit stream is unframed or has an unidentified framing format.

**BPV LED:**
- flashes on briefly for each detected bipolar violation.
- is lit solid when the BPV density exceeds 1 BPV/40 ms.

**FR BIT ERR LED:**
- flashes on briefly for each detected occurrence of a frame bit error while framing prevails.
- is lit solid when the frame bit error rate exceeds 1 error/ 40 ms while framing prevails.

**CRC ERR LED:**
- flashes on briefly for each detected occurrence of a CRC code error while ESF framing prevails.
- is lit solid when the CRC code error rate exceeds 1 CRC/ 40 ms while ESF framing prevails.

**FR LOSS LED:**
- is off when framing prevails.
- flashes on briefly each time framing is lost and quickly reacquired
- is on while framing is lost.

**BIT ERR LED:**
- flashes on for each detected bit error once pattern synchronization prevails (SYNCH LED lit).
- is lit solid when the bit error rate exceeds 1 bit error/40 ms while pattern synchronization prevails.
- is turned off otherwise.

**AIS LED:**
- is lit while the all-ones (framed or unframed) code is detected for a minimum duration of 40 ms if DIP switch S2/4 is set to ON. If DIP switch S2/4 is set to OFF, only an unframed all-ones code causes this LED to light.

**YEL ALARM LED:**
- is on only when the SF yellow alarm code is present for over 30 ms or when the ESF yellow alarm code is received at least 14 consecutive times.
- is off otherwise.

**SYNCH LED:**
- is lit solid when the receiver bit pattern is synchronized to the incoming bit pattern.
- turns off when the bit error rate becomes excessive or when synchronization has not been achieved.

**B8ZS LED:**
- is lit for at least one second whenever the monitored bit stream contains the B8ZS code. When this happens, the HISTORY register captures this occurrence but the History LED is not flashing.

### 4.4.2 VFDT Display

Additional DS1 measurements displayed in real-time by the VFDT are given below. These measurements are obtained by momentarily depressing the DS1 STATS key or the T1 MEAS key in the Control and Measurements section.

## - DS1 STATS

Depressing the DS1 STATS key causes the VFDT to display the DS1 statistics menu below which allows access to the error count, errored seconds, and error rate data.

```
DS1 STATISTICS
              CNT  SEC  BER
               #    #    #
```

The data displayed when one of the DS1 STATS screen softkeys, CNT, SEC or BER, is depressed are accumulated and/or processed during the test time period only. This period is selected from the TEST TIME menu; it is started when the RESTART key is momentarily depressed. Refer to Chapter 3 for instructions on setting the TEST TIME.

At the end of the test period, a flashing T appears above BER to tell you that the test has timed out. If the receiver detects a loss of signal resulting from pulling the plug from the PCM INPUT jack, a flashing F appears above BER to indicate that the counts are now frozen.

Any of the DS1 STATS can be viewed during the test period as well as after the test period has timed out. These statistics can also be down-loaded to a printer if the 235A is equipped with option 02.

### CNT

When you depress the DS1 STATS CNT softkey, a screen similar to screen [1] is displayed on the VFDT. This screen shows the number of bit errors (if the SYNCH LED is lit) and CRC errors (if ESF framing prevails only) that have occurred since the start of the test period. Each time the BIT or CRC LED in the diagnostic receiver flashes, the counts increment if the programmed test period has not yet elapsed. Bit errors are detected and counted only if the diagnostics receiver is synchronized to the incoming bit pattern. The screen also indicates the bit pattern to which the receiver is synchronized. For example, screen [1] indicates that the DS1 receiver is synchronized on a pseudo-random pattern of length $2^{20}$-1. If no pattern is recognized, (NONE) appears next to BIT.

When the auto-search mode is disabled (S2/7 set OFF), the receiver uses the transmitter's pattern as reference for synchronization. If the auto-search mode is enabled (S2/7 set ON) the receiver sequentially uses each of the non-channelized patterns in the DS1 transmitter library as reference for synchronization.

Screen [1]

```
BIT (2^20)      CRC ERR
     6              3    NXT
                         #
```

At the end of the test period, a flashing T appears above NXT to tell you that the test has timed out. If the receiver detects a loss of signal resulting from pulling the plug from the PCM INPUT jack, a flashing F appears above NXT to indicate that the counts are now frozen as described above.

Depressing the NXT softkey on screen [1] brings up screen [2]. This screen yields the number of BPV's and frame bit errors that have occurred since the start of the test period. Again, these counts increment each time the corresponding LED in the DS1 diagnostic receiver section flashes during the test.

A flashing T or F may appear above NXT as was described for screen [1].

Screen [2]

```
  BPV   FR B  ERR
   6        3        NXT
                      #
```

Depressing the NXT softkey in screen [2] returns you to the main DS1 STATS screen.

**SEC**

Pressing the SEC (seconds) softkey and using the NXT softkey brings up the sequence of displays shown in screens [3] through [7].

Screen [3]

| ERR-SEC | SES | |
|---|---|---|
| 4 | 0 | NXT |

#

Screen [3] displays the number of errored seconds and severely errored seconds. An errored second is a second in which one or more of the following events have occurred: >15 0's, LOS, BPV, FR BIT ERR, CRC ERR, or BIT ERR. A severely errored second is a second in which one or more of the following events have occurred: >1544 BPV's, >11 FR BIT ERRs, >320 CRC ERR, FR LOSS.

**Remarks**

Errored seconds and severely errored seconds are mutually exclusive. When unframed pattern synchronization prevails, the resulting frame loss does not cause the severely errored second counter to increment.

Screen [4]

| CSES | FR L-SEC | |
|---|---|---|
| 0 | 0 | NXT |

#

Screen [4] shows consecutive severely errored seconds and frame loss seconds. The consecutive severely errored seconds counter is incremented by one when three or more severely errored seconds have occurred.

Screen [5]

| EFS | %EFS | |
|---|---|---|
| 101 | 99.84 | NXT |

#

Screen [5] shows error free seconds and percentage of error free seconds. An error free second is a second in which no impairment has occurred. Percentage of error free seconds is 100 times the number of error free seconds divided by the total number of seconds elapsed in the test (since the last RESTART).

Screen [6]

| SYNC | L-SEC | (QRS) | |
|---|---|---|---|
| | 5 | | NXT |

#

Screen [6] displays sync loss seconds and the bit pattern on which the receiver is synchronized (only if the receiver is synchronized on a pattern).

Screen [7]

| AIS-SEC | YL | ALM-SEC | |
|---|---|---|---|
| 5 | | 0 | NXT |

#

Screen [7] shows the number of seconds the all 1's pattern and the yellow alarm code have been received during the test period. The VFDT displays the main DS1 STATS screen upon depression of the NXT softkey in screen [7].

**BER**

The BER key gives you access to a series of displays that yield the bit error rate based on the number of bit errors (BER). Screens [8] through [11] illustrate these measurements.

The error rate is computed only when the number of accumulated errors exceeds 3. When this is not the case, or if the error rate is smaller than $0.1 \times 10^{-9}$, the measurement value field reads "LOW ERROR". If the error rate exceeds $9.9 \times 10^{-3}$, the measurement field reads "HIGH ERROR". Table 4-1 lists the measurement ranges.

If the number of errors for a particular BER reaches 999,999, the BER flashes, indicating that it may not be entirely accurate.

Screen [8]

| | |
|---|---|
| BER (CODE) | |
| LOW ERROR | NXT |

#

Screen [9]

| | |
|---|---|
| BPV BER | |
| LOW ERROR | NXT |

#

Screen [10]

| | |
|---|---|
| FRAME BER | |
| $2.2 \times 10^{-9}$ | NXT |

#

Screen [11]

| | |
|---|---|
| CRC BER | |
| $2.4 \times 10^{-9}$ | NXT |

#

To return to the main DS1 STATS screen, depress the NXT softkey in screen [11].

**- T1 MEAS**

Momentarily depressing the T1 MEAS key in the Controls and Measurements section brings up screen [12].

Screen [12]

| | |
|---|---|
| 2.97 V | -0.1 dBDSX |
| 1,543,995 Hz | NXT |

#

The peak amplitude measurement of the signal presented at the DS1 RECEIVE yields the level expressed in both volts and dBDSX when SEL 2 is set on DSX. In this case, the level measurement is given independently of the type of pattern as long as this level is in the range of + 3.0 to -6.0 dBDSX. A reading of 0.0 dBDSX corresponds to a nominal base to peak pulse amplitude of 3.0V.

The energy contained in the signal presented at the DS1 RECEIVE is measured to also yield the level when SEL 2 is on LO LVL. In this case, the level measurement requires the pattern to be all ones with or without framing. The level must be in the range of -6 to -35 dBDSX.

The frequency of the PCM signal applied at the DS1 RECEIVE INPUT is also measured on an ongoing basis and is updated once per second. The acceptable frequency range is nominally 1,544,000 +/- 500 Hz.

Depressing the NXT softkey in screen [12] causes the VFDT to display the bit-by-bit slippage and the frame slip counts accrued over time. The slippage is displayed in real time; it is representative of the instantaneous difference in the clock rates taking place between the PCM signals applied at the DS1 RECEIVE DIAGNOSTICS INPUT and at the DS1 REF INPUT. Screen [13] shows the slippage display.

Screen [13]

```
SLIPPAGE  CNT:        37
 =------|----        NXT
                      #
```

The slippage display consists of a stack on the left and a scale under the SLIPPAGE heading. Together, the marker on the scale and the height of the stack represent the instantaneous delay between a reference bit position on the two PCM bit streams. When the two observed bit streams have precisely the same clock frequency and the instrument has been reset, the stack is empty and the marker sits in the middle of the scale.

If the clock frequency of the bit stream presented at the diagnostics receiver input is higher than the clock frequency of the bit stream presented at the reference receiver input, the stack increases in height one layer at a time. Each layer represents one bit of slippage. When the stack reaches its full height, it is emptied and the marker on the scale advances to the right, one position. This process repeats itself until finally the marker falls off the edge of the scale. At the same time, the (frame slip) COUNT is incremented.

If the clock frequency of the bit stream applied at the DS1 diagnostics receiver is lower than the clock frequency of the signal applied at the reference receiver, the stack decreases in height by one layer for each bit slipped and the marker moves from the center to the left edge of the scale. The stack is six bits high and there are 32 horizontal marker positions between the center and edges of the scale. Each count therefore represents 193 slipped bits.

A flashing T or F may appear near the COUNT value to indicate time-out or withdrawal of the plug from the PCM INPUT jack as was described for screen [1].

When you depress the NXT softkey in screen [13], screen [14] is displayed if there is 60 mA of current present on the line.

Screen [14]

```
SPAN LINE CURRENT:
     60     mA DC      NXT
                        #
```

The 235A measures span line current in the range 50 mA to 150 mA. If there is no current on the span line, the VFDT displays 'NONE'.

**Note**

To measure Span Line current both the transmitter and receiver must be connected to the span.

**CAUTION**

To avoid damage to the test set and to protect the user from electrical shock, always connect the patchcords into the 235A before patching the cords to the wet circuit jacks.

- DS0 MEAS

Screen [15]

| DS0 OPTION (54B)<br>IS NOT INSTALLED |
|---|

If the 235A is not equipped with an add-on module, screen [15] is displayed when the DS0 MEAS key is depressed.

If your 235A is equipped with a 54B DS0 monitor, depressing this key displays the DS0 measurement menu. Details of these options and associated menus are given in Chapter 7 of this manual.

- SUMMARY

Depressing and holding the SUMMARY key in the Control and Measurements section causes screen [16] and the diagnostic history to be displayed.

Screen [16]

| DISPLAYING<br>HISTORY CLR |
|---|

#

The HISTORY feature consists of lighting the LEDs in the DS1 Receive Diagnostics section associated with the errors which have occurred during the most recent test period (i.e. since the last RESTART). These LEDs remain lit while the SUMMARY key is held down. If the HISTORY LED is not flashing, no ERROR LEDs turn on when depressing the summary key. Depressing the CLR softkey clears the History but does not clear any event counter or reset the test timer.

Screen [17]

| DS1 SYNC (QRS)<br>ALL RESULTS OK |
|---|

A screen similar to screen [17] is displayed upon release of the SUMMARY key. This screen displays the pattern on which the receiver is synchronized as well as a summary of error counts accumulated during the test period (i.e. since the last RESTART). Screen [17] indicates that the receiver is synchronized on the QRS pattern and that no errors have been detected during the current test period.

Screen [18]

| DS1 SYNC (QRS)<br>BIT ERRS: 1 NXT |
|---|

#

If errors have occurred during the most recent test period, a screen similar to screen [18] is displayed by the VFDT.

The second line of the VFDT displays the error event(s) which have occurred since the last RESTART. The following events may be displayed: BIT ERRS, BPV ERRS, FR B ERRS, CRC ERRS, SYNC L SEC, ERR SECS, SES, CSES, FR L SECS, YL AL SEC and AIS SECS. Depressing the NXT softkey in the above screen causes the VFDT to display the next error event in the above sequence, only those events having occurred are displayed.

The top line of the VFDT displays "SYNC LOSS (patt)" if the receiver has lost synchronization; patt is the last pattern on which the receiver was synchronized.

Screen [19]

```
SEARCHING
      ALL RESULTS OK
```

If the 235A is in the autosearch mode, the VFDT displays screen [19] while the receiver is searching for the pattern.

Screen [20]

```
LIVE DATA
      ALL RESULTS OK
```

Upon completion of its search, the 235A displays a screen similar to screen [17] if the pattern is recognized. If the 235A does not find a matching pattern in its library, a screen similar to screen [20] is displayed.

If the unrecognized bit stream is unframed, the VFDT displays "UNFRAMED DATA". If the received bit stream is the AIS (all 1's) signal, the VFDT shows "AIS DATA".

A flashing F appears in the lower right of the VFDT if the counts have been frozen due to the removal of the patchcord from the PCM INPUT. A flashing T appears in the lower right corner of the screen if the set test time has expired.

If errors are only detected after the set test time has expired, the HISTORY LED flashes as well as the error LED and the VFDT displays screen [21].

Screen [21]

```
DS1 SYNC (QRS)
  NO COUNTS DETECTED T
```

## 4.5 MEASUREMENT SUMMARY

Table 4-1 summarizes all of the diagnostic receiver measurements that are displayed. It also gives error criteria and/or the range of display. Also included in this summary are some notes on CRC errors, frame bit errors and frame loss seconds.

**Table 4-1. Measurement definitions, ranges and criteria**

| Measurement | Definition | Range/Criteria |
|---|---|---|
| OVERLOAD | Input PCM level | >3dBDSX |
| LOS | Loss of signal | >175 consecutive zeros |
| >15 0's | Consecutive 0 bits | >15 |
| <12.5% | Density of 1 bits | <3 out of 24 bits |
| BPV | Bipolar violations | 0 to 999999 |
| BPV BER | Error rate based on BPV's | $.1 \times 10^{-9}$ to $9.9 \times 10^{-3}$ |
| FR BIT ERR | Frame bit errors | 0 to 999999 |

*(Continued)*

*Table 4-1. (continued)*

| Measurement | Definition | Range/Criteria |
|---|---|---|
| FRAME BER | Frame bit error rate<br># FR bit ERRS/# frames | .1 x $10^{-9}$ to 9.9 x $10^{-3}$ |
| CRC ERR | CRC-6 errors | 0 to 999999 |
| CRC BER | CRC-6 bit error rate<br># CRC-6 ERRs/# bits | .1 x $10^{-9}$ to 9.9 x $10^{-3}$ |
| FR LOSS | Loss of frame | 2 frame bit errors in 5 frames |
| FR LOSS-SEC | Seconds w/lost framing | 0 to 999999 |
| BIT ERR | Bit errors | 0 to 999999 |
| BER | Bit error rate | .1 x $10^{-9}$ to 9.9 x $10^{-3}$ |
| AIS | All 1's pattern | >40 ms of all 1's |
| AIS-SEC | Seconds in which the all 1's code occurred | 0 to 999999 |
| YEL ALARM | Yellow alarm<br>SF/SLC-96 | bit 2 in each channel = 0 for 30 ms. |
| YEL ALARM | ESF | 14 consecutive sequences of eight 1's followed by eight 0's |
| YEL ALARM-SEC | Seconds in which the yellow alarm occurred | 0 to 999999 |
| ERR-SEC | Seconds w/ one or more errors | 0 to 999999 |
| SEV ERR-SEC | Seconds in which one or more of the following occurred<br>- over 320 CRC errors<br>- over 1544 BPV's<br>- over 11 frame bit errors<br>- frame loss | 0 to 999999 |
| CSE-SEC | 3 or more consecutive SEV ERR-SECs | 0 to 999999 |
| ERR-FREE-SEC | Seconds in which no errors have occurred | 0 to 999999 |
| %ERR-FREE-SEC | 100 x the number of error free seconds/total number of test seconds | 0 to 100 |

*(Continued)*

*Table 4-1. (continued)*

| Measurement | Definition | Range/Criteria |
|---|---|---|
| SYNC LOSS-SEC | Seconds in which bit pattern synch is lost | 0 to 999999 |
| SLIP-COUNT | Absolute # of slipped bits/193 | 0 to 999999 |
| LEVEL | DS1 peak meas. (dBDSX) | -3.0 to +3.0 |
| | DS1 Energy meas. | -6.0 to -35.0 |
| FREQUENCY | DS1 Bit rate | 1,544,000 ± 500 Hz |

**- CRC Errors**
This type of error can only be found when monitoring ESF formatted bit streams. An error is detected when the 6-bit signature received along with an extended superframe does not match the 6-bit word computed by the diagnostic receiver for the same extended superframe. When this is the case, one or more bits have been corrupted in a block of 4614 bits.

> **Note:**
> CRC errors are only counted when there is ESF framing. If framing is lost over a significant part of the monitored period, the CRC count is then lower than fact.

**- Frame Bit Errors**
For any system selection, framing bit errors Ft are monitored and captured. Framing bit error counting is disabled during framing loss to avoid false counting. If framing is lost over a significant portion of the monitored period, the frame bit error count may be lower than fact.

**- Frame loss-seconds**
The frame loss-second counter increments by one count for each second during which framing is lost when a plug is inserted in the diagnostic receiver's INPUT PCM jack. The frame loss count is incremented whether the frame loss exists for only a small fraction of a second or for a very long time. Under ordinary conditions, frame loss occurs primarily as a result of substantial burst-error activity, or when the PCM signal is lost.

## 4.6 IN-SERVICE MONITORING APPLICATION INFORMATION

In recent years, in-service testing has become increasingly popular. This has come partly from the recognition of the measurement validity and usefulness and partly from the frequent impracticality of turning a system down to perform traditional out-of-service testing. This section discusses a number of in-service testing related issues as well as the applicability of the measurements described in the previous sections.

### 4.6.1 In-Service BER Measurement

Although BER measurement is generally thought of as an out-of-service based measurement, it is possible to obtain an excellent estimation of the true bit error rate sustained by the DS1 formatted transmission without interfering with the traffic. Three methods yielding indirect BER measurements are discussed in this section.

**- BPV based BER**
Because higher level multiplexers (M12, M13 etc.) are not transparent to BPVs, the BPVs observed on a circuit must have been created in the transmission segment from the test point to the nearest multiplexer. As a consequence, the counting of BPVs offers a handy way of isolating the location of an impairment source to a specific link in the network.

An excellent correlation exists between BPV BER and the true bit error rate (BER) when the BPV BER is $10^{-3}$ or less. When the error rate is greater than $10^{-2}$, cancellation of BPVs occur more frequently. This yields a less accurate (or more favorable) BER measurement.

**- CRC based BER**
When monitoring ESF formatted DS1 transmission, the CRC-6 error rate yields a good approximation of the actual bit error rate when the observed rate is $10^{-6}$ or smaller. When the BER is significantly greater than this value, the accuracy is reduced. This results from the fact that a CRC error is declared when one OR MORE bit errors have been introduced in a field of 4632 bits (24 frame/ESF). When the error rate decreases, so does the probability that more than one bit error occurs in a block of 4632 bits, and thus one CRC error is more likely to represent one bit error. In short, the CRC BER is a dependable BER measurement when the CRC BER is $10^{-6}$ or smaller. The main shortfall of this measurement is that it only applies to ESF formatted DS1 transmission.

**- Frame bit based BER**
The computation of the FRAME BER by the 235A yields a very good estimate of the true BER and is applicable to both SF and ESF formatted DS1 bit streams. The main disadvantage of this technique is that it requires typically a long test time when the BER is small ($1x10^{-8}$ or less). The usability of the FRAME BER to characterize the entire bit stream rests on the observation that PCM transmission corrupts every bit with the same probability. As a consequence, the bit error rate computed for one bit is statistically the same as for all the other bits if the test period is sufficient. The required test period depends on the desired accuracy of the measurement and of the BER itself since a minimum number of errors must be observed to obtain a meaningful measurement. To help in determining the minimum required period of monitoring, refer to the graph in Figure 4-1. The graph is based on the minimum time required to acquire 4 frame bit errors as a function of the anticipated BER for both SF and ESF formatted transmission.

It should be noted that the values obtained from this chart are only the minimum, and that overall measurement accuracy is always increased by exceeding the given values.

To use the graph in Figure 4-1, select the expected BER on the vertical axis and extend a horizontal line to the slanted line corresponding to the transmission format used. Mark the intersection with a dot. A line drawn vertically from the dot to the horizontal axis yields the minimum needed test time.

For example, if a D3/D4 system is expected to exhibit an average bit error rate of $5x10^{-7}$ errors/bit, the minimum required observation time is approximately 2000 seconds (just over 1/2 hour).

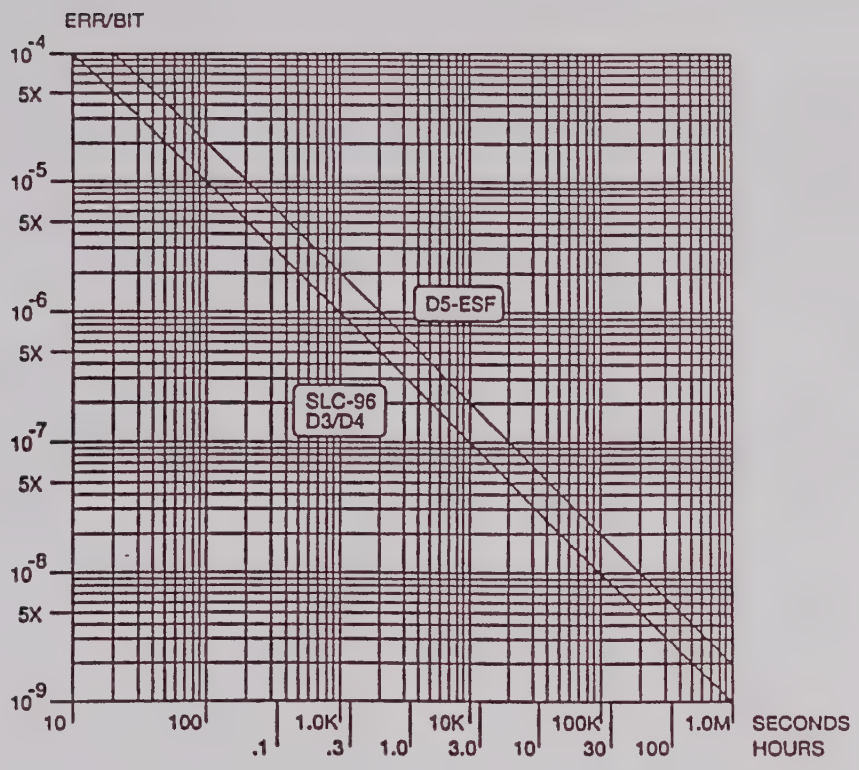



Figure 4-1 Minimum Required Test Time

### 4.6.2 Slippage Measurement Applications

The bit slippage display capability built-in the 235A has a number of practical applications. Some of the most useful ones are described in this section.

**- Loop Timing Integrity Check**

The loop timing integrity of a channel bank can be performed without taking the bank out of service by simply monitoring the XMT and RCV bit streams simultaneously with the DS1 REF and the DS1 RECEIVE DIAGNOSTICS. Timing integrity is indicated when no shift in the slip display marker is observed over an extended period of time. To simplify the observation, it is best to RESTART the 235A after the two PCM signals are applied to the PCM inputs and to note that the stack remains empty and the marker stays at the midpoint of the scale.

Lack of loop timing or loss of phase locking integrity is normally evidenced by a drift of the marker in one direction at a relatively constant rate.

**- Jitter and Frequency Wander Detection**

When jitter or frequency wander takes place between two PCM bit stream clock frequencies, the slippage marker position and the level of the stack are forever randomly changing. The position of the marker or the size of the stack only provide qualitative information of the amount of jitter. However,

the magnitude of the frequency wander in bits can be readily evaluated by noting the peak-to-peak magnitude of the displacement of the marker on the scale.

**- Frame Slip Counting**

The frame slip counting capability offered by the 235A is based on the premise that one frame slip count accrues when 193 bits of slippage have accumulated between the two monitored bit streams. In the absence of a standard, this number of bits has been arbitrarily selected. In practice, different digital switch makers have arbitrarily selected different values to reflect the underflow or the overflow of a buffer whose length may be 256 bits, 512 bits or yet other values. Consequently, frame slip counts on the 235A may differ significantly from the counts observed by the digital switch without raising a suspicion that either machine is defective. On the other hand, if one machine indicates a significant number of slips, say 10 or 12, and the other indicates 0, one of the two machines is suspect.

### 4.6.3 Impairment Data Recording

When the 235A is equipped with option 02, a time and date stamped record of the impairment activity monitored by the 235A can be obtained. Additional information on the use of this capability is provided in Chapter 12.

# CHAPTER 5
## USING THE DS1 TRANSMIT CAPABILITIES

### 5.1 INTRODUCTION

The 235A DS1 Transmit section can generate a large number of framed and unframed test patterns and simulate many transmission impairments. These capabilities are most useful for testing and characterizing a transmission facility prior to its placement in service and when maintaining transmission equipment in an out-of-service basis. This chapter describes how to use all the DS1 Transmit capabilities; except for the programmed tests (described in Chapter 6) and the fractional T1 tests (described in Chapter 8). The chapter is divided in six main sections:

- Generating DS1 test patterns
- Generating Long User patterns, option 03A
- Generating the yellow alarm
- Simulating impairments
- Generating loop codes
- LOOP MODE operation.

> **REMARK:**
> When a programmed test is active (LED in PROG TEST key is lit), the controls in the DS1 TRANSMIT section are not operational.

### 5.2 GENERATING DS1 TEST PATTERNS

The DS1 test pattern you require is generally defined by five parameters:

- nature of the pattern
- type of framing
- clock source
- line format
- output level.

The 235A allows you to individually select these parameters and to introduce transmission impairments and yellow alarm in the delivered bit stream.

#### 5.2.1 DS1 PATTERN SELECTION

Screen [1]

| | | | | |
|---|---|---|---|---|
| 3/24 | 1/8 | 1/1 | QRS | |
| CHAN | | UFR | FR | NXT |
| | | # | # | # |

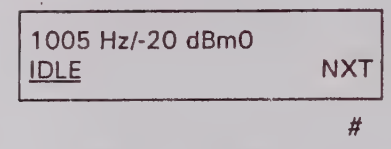
By depressing the DS1 PATT key in the DS1 Transmit section, screen [1] is displayed by the VFDT.

By using the right (>) or left (<) pointing keys, the pattern underline can be moved to the adjacent selection. The underline at the UFR (unframed) or FR (framed) selections is shifted by depressing the UFR and the FR softkeys respectively. The DS1 Transmit section delivers at the T1 output the current selection. For example, if QRS and FR are underlined, as shown in screen [1], the signal present at the T1 output is the QRS signal ($2^{20}$-1 with 14 zeros substitution) with embedded framing

pattern. The 3/24 pattern is a bit sequence consisting of three ones and 21 non-consecutive zeros used mainly for stress testing facilities containing repeaters. When the 1/1 selection is underlined, the PCM pattern delivered by the DS1 transmitter is the framed or unframed all-ones (111111...) pattern. When the 1/8 selection is underlined, the pattern delivered consists of a framed or unframed series of (01000000) bytes.

The CHANnelized selection is always framed; it gives you the choice of sending in each DSO channel the same byte sequence. The CODE selection allows you to select a framed or unframed arbitrary combination of ones and zeros of length 1 to 24 bits. Depressing the EDIT key when the CHAN selection is underlined causes the VFDT to display a screen similar to screen [2]. The current selection is underlined. If IDLE is selected, each DSO channel contains the code 11111111.

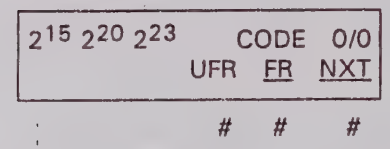
Screen [2]



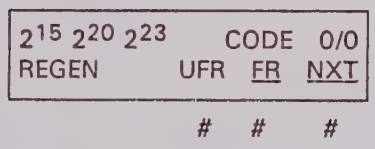

When the 1005 Hz/-20 dbm0 header is underlined, each of the 24 DSO channels contains this tone in a digitized form. In both cases, the signaling state for the A, B, C, and D bits is 1.

When the NXT softkey in screen [1] is depressed, a screen similar to screen [3] or screen [4] is displayed by the VFDT.

Screen [3]



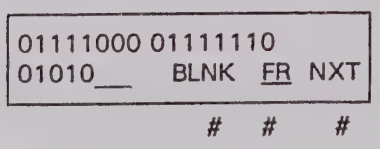

Screen [4]




Screen [3] is displayed when S2 position 7 (autosearch) is OFF; screen [4] is displayed when S2 position 7 is ON. The underlined NXT header indicates that the current pattern selection is given in the previous screen. The underlined FR header indicates that this selection is framed. To change the pattern selection, depress either pointer keys; this causes the underlined NXT header to shift to one of the other pattern selections. The $2^{15}$, $2^{20}$ and $2^{23}$ are alternate quasi-random bit pattern sequences.

Depressing the EDIT softkey when the CODE selection is underlined causes the VFDT to display a screen similar to screen [5].

Screen [5]




Screen [5] represents a string of 21 bits previously stored in the battery backed memory. The DS1 transmitter delivers this bit sequence over and over starting from the leftmost bit in the top line and ending with the rightmost bit in the bottom line. If the middle softkey header reads FR, this stream is framed. Depressing this softkey causes its header to be changed to UFR and the bit stream to be unframed.

You can edit screen [5] to create any arbitrary bit pattern from 1 to 24 bits. The screen shows solid underlines for bits that are not being used; the flashing underline acts as a cursor. The left and right arrow keys are used for moving the cursor to the desired bit position in the string. You use the 1 and 0 keys above the cursor keys to define the state of each bit in the desired pattern. To add a bit to the pattern, use the 1 or 0 keys in the position passed the last bit position.

The BLNK softkey allows you to shorten the length of the pattern. Depressing this key causes the bit at the cursor and all the bits immediately to its right (if any) to be blanked-out.

0/0 is an all zeros pattern. A framed, all zeros pattern, using B8ZS as the line code, is used to verify that a system, passing through multiple facilities, is optioned correctly for B8ZS. If an attempt is made to send the pattern with AMI line code, a message "This Pattern will cause LOS w/o B8ZS" is displayed for 4 seconds.

The REGEN selection enables the DS1 transmitter to deliver a REGENerated version of the pattern received by the DS1 receiver when this pattern has been identified (i.e. synchronized on). Any errors in the received pattern are cleaned up in the REGENerated bit stream.

When the REGEN selection in screen [4] is underlined and the DS1 receiver is synchronized (SYNC LED is lit), that pattern is regenerated by the DS1 transmitter. If pattern synchronization is not acquired by the receiver, an all-ones pattern is delivered by the transmitter.

Screen [6]

```
The T1 output stream
is now =   AUX   DS1   IN
```

The current DS1 selection can be overridden by a bit stream externally supplied to J1, the AUX. DS1 input jack located on the right hand side panel. While the signal supplied to this jack is compatible with the interface requirements (100 ohms nominal input impedance; 0 dBDSX level) and the DS1 PATT key is in the FLOSO state, the VFDT displays screen [6].

### 5.2.2 LONG USER PATTERN GENERATION

If your 235A is not equipped with option 03A, the capabilities described in this section are not available. Pressing the NXT softkey in screen [3] or [4] will return you to screen [1].

When equipped with option 03A, the 235A can generate a series of pre-programmed long test patterns. It also generates four long user programmable patterns, each from 1 to 256 bytes in length.

Pressing the NXT softkey in screen [3] or [4] causes screen [7] to be displayed.

Screen [7]

```
55-OCTET    TRIP  TEST
            UFR   FR   NXT
              #    #    #
```

To cause the 55-OCTET pattern to be delivered to the T1 OUTPUT of the transmitter, simply press the arrow key until 55-OCTET is underlined. This pattern, also known as the Daley Pattern, consists of the 55 byte sequence as follows:

55-OCTET

| | Binary | Hex |
|---|---|---|
| 6 Bytes of | 10000000 | 01 |
| 1 Byte of | 00000001 | 80 |
| 6 Bytes of | 10000000 | 01 |
| 1 Byte of | 11000000 | 03 |
| 4 Bytes of | 10000000 | 01 |
| 1 Byte of | 11100000 | 07 |
| 4 Bytes of | 10000000 | 01 |
| 4 Bytes of | 10101010 | 55 |

*(Continued)*

*55-OCTET*

| | Binary | Hex |
|---|---|---|
| 4 Bytes of | 01010101 | AA |
| 6 Bytes of | 10000000 | 01 |
| 6 Bytes of | 11111111 | FF |
| 6 Byte pairs of | 00000001 10000000 | 80 01 |

**Note**

Bytes are transmitted least significant bit first. Many documents, such as T1M1.3/91-002R1, reverse the binary representation of the HEX code (the binary code is printed least significant bit first). For example, 01 in hex is represented by 10000000 instead of 00000001. Therefore, HEX is transmitted right to left and BINARY is transmitted left to right. This is the convention followed throughout this manual.

This pattern is useful for stressing line card timing recovery circuitry and repeater equalization and preamplifier circuits. It stresses the circuits with rapid transitions between long low density byte sequences and high density byte sequences.

The TRIP TEST pattern in screen [7] may also be selected. This is another useful byte sequence for stressing facilities. It consists of 96 bytes as follows:

| | Binary | Hex |
|---|---|---|
| 48 Bytes of | 11111111 | FF |
| 4 Bytes of | 01010101 | AA |
| 10 Byte sets of | 00000001 10000000 | 80 01 |
| 4 Bytes of | 01010101 | AA |
| 10 Byte sets of | 00000001 10000000 | 80 01 |

Screen [8]

| | | |
|---|---|---|
| USER-1 | USER-2 | USER-3 |
| USER-4 | | NXT |

Depressing the NXT softkey in screen [7] causes the VFDT to display screen [8], the Long User Defined Pattern menu.

USER-1 and USER-2 are preprogrammed patterns which are useful for stressing different pieces of network equipment. They consist of the following byte sequences:

USER-1 (120 Octet)

| | Binary | Hex |
|---|---|---|
| 72 Bytes of | 11111111 | FF |
| 4 Bytes of | 01010101 | AA |
| 20 Bytes of | 00001000 | 10 |
| 4 Bytes of | 01010101 | AA |
| 20 Bytes of | 00001000 | 10 |

USER-2 (53 Octet)

| | Binary | Hex |
|---|---|---|
| 15 Byte pairs of | 00000001 10000000 | 80 01 |
| 1 Byte of | 10000000 | 01 |
| 1 Byte of | 11110101 | AF |
| 1 Byte of | 01010101 | AA |
| 1 Byte of | 11110101 | AF |
| 4 Bytes of | 10000000 | 01 |
| 4 Bytes of | 11111111 | FF |
| 4 Bytes of | 10000000 | 01 |
| 6 Bytes of | 11111111 | FF |
| 1 Byte of | 11010011 | CB |

USER-3 is another variable length long test pattern which you may program. The factory setting for this byte sequence is the MINMAX pattern which consists of the following octets (Hexadecimal representation. See Table 5-1 for hex to binary conversion):

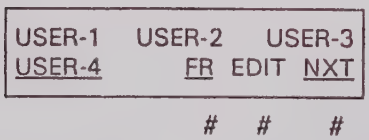
80, 80, 80, 80, 01, 00, 01, 01,
01, 03, 80, 01, 80, 01, 01, 80,
01, 22, 00, 20, 22, 00, 20, AA,
AA, AA, AA, AA, 55, 55, 55, 55,
AA, AA, AA, AA, 55, AA, AA, 55,
55, 55, 80, 80, FF, FF, FF, FF,
FF, FF, FF, FE, FF, FF, 24, 49,
92, 88, 88, 88, 10, 42, 08, 21,
84, 20, 08, 82, 40, 20, 10, 80

USER-4 is factory set to the 7 bit ASCII "Quick Brown Fox" pattern. This byte sequence consists of the following octets:

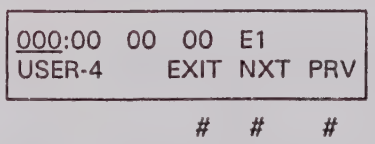
54, 48, 45, 20, 51, 55, 49, 43,
4B, 20, 42, 52, 4F, 57, 4E, 20,
46, 4F, 58, 20, 4A, 55, 4D, 50,
53, 20, 4F, 56, 45, 52, 20, 54,
48, 45, 20, 4C, 41, 5A, 59, 20,
44, 4F, 47, 20, 31, 32, 33, 34,
35, 36, 37, 38, 39, 30, 0D, 0A

All four long user-defined patterns may be edited as desired to form test patterns from 1 to 256 bytes in length. To change a USER pattern select it in screen [8] using the cursor keys. For example, if you select USER-4, the 235A will transmit the previously defined USER-4 pattern and the VFDT will display screen [9].

Screen [9]




Screen [10]




Depressing the NXT softkey in screen [9] causes screen [10] to be displayed and allows the editing of the USER-4 test pattern.

The USER test patterns are entered in hexadecimal. Each pair of hexadecimal digits represents eight bits. Refer to Table 5-1 for the conversion between hexadecimal, decimal and binary.

Table 5-1 Hexadecimal Conversion

| Hexadecimal | Decimal | Binary |
|---|---|---|
| 0 | 0 | 0000 |
| 1 | 1 | 0001 |
| 2 | 2 | 0010 |
| 3 | 3 | 0011 |
| 4 | 4 | 0100 |
| 5 | 5 | 0101 |
| 6 | 6 | 0110 |
| 7 | 7 | 0111 |
| 8 | 8 | 1000 |
| 9 | 9 | 1001 |
| A | 10 | 1010 |
| B | 11 | 1011 |
| C | 12 | 1100 |
| D | 13 | 1101 |
| E | 14 | 1110 |
| F | 15 | 1111 |

The underlined 3 digit number in the upper left of screen [10] (000) is the number of the first octet (byte) which is displayed immediately to the right of the colon. screen [10] displays 4 of the 256 octets in USER-4, octets 000 through 003. These first 4 octets are 00, 00, 00 and E1. Note that 2 hexadecimal digits make up an octet (eight bits). Depressing the NXT softkey in screen [10] causes the VFDT to display the next 4 bytes in USER-4. The three digit number in the upper left of the screen will now read 004 indicating that bytes 4 through 7 are displayed on the VFDT. Each successive depression of the NXT softkey will cause the VFDT to display the next 4 bytes in the test pattern. When the last byte of the pattern is reached, depressing the NXT softkey causes the first four bytes to be displayed again. The PRV softkey allows you to scroll through the octets in reverse by causing the VFDT to display the previous four bytes with each depression.

To edit the four displayed octets depress the right arrow key (>). This will cause screen [11] to be displayed.

Screen [11]

```
000:00  00  00  E1
USER-4      BLNK  UP  DN
            #     #   #
```

To change the hexadecimal digits use the arrow keys to move the cursor to the desired digit and use the UP and DN softkeys to increment or decrement respectively. The 1 and 0 keys may also be used to enter a one or a zero hexadecimal digit.

**Note**

Depressing the BLNK softkey will truncate the test pattern. All digits to the right of the cursor, including all the bytes in subsequent screens, will be 'Blanked Out', and all previously entered data in those bytes will be lost. For example if the BLNK softkey is depressed in screen [11], after moving the cursor to the 2nd byte, the USER-4 test pattern will consist of a repeating 00 (Hex).

Screen [12]

```
052:BD   3E  __  __
USER-4       BLNK  UP  DN
             #     #   #
```

To add bytes to the end of a USER-defined code with less than 256 octets, move the cursor to the right of the last byte and use the UP or DN softkey. In screen [12] the cursor would be moved to the byte 53 immediately to the right of 3E to add more octets to USER-4.

Moving the cursor to 000 causes the VFDT to display screen [10] with the new octet values. To edit the next four octets, depress the NXT softkey. Next press the right arrow key and repeat the above procedure.

After the USER pattern has been edited, depress the EXIT softkey in screen [10] to return to screen [9].

> **Note**
> The long user pattern may also be edited from a terminal with the USER command provided your 235A is equipped with option 02, RS-232-C Interface. See Chapter 12 for details.

The Long User Pattern may be sent either framed or unframed. This selection is made with the leftmost softkey in screen [9].

Screen [13] is displayed by the VFDT after the NXT softkey is depressed in screen [11] or [12].

Screen [13]

```
DDS-1     DDS-2   DDS-3
DDS-4       UFR   FR   NXT
                  #    #    #
```

Screen [13] displays the DDS test pattern menu. Any one of these repetitive patterns can be selected by moving the cursor. The four DDS patterns were originally specified for testing DDS circuits but are also used to stress fractional T1 facilities and equipment as is described in Section 9.3. These patterns may also be used at the DS1 rate and are made available to provide a greater variety of long T1 stress patterns. DDS-1 through DDS-4 are defined below:

DDS-1: 100 octets of 11111111 (FF hex) followed by 100 octets of 00000000 (00 hex)

DDS-2: 100 octets of 01111110 (7E hex) followed by 100 octets of 00000000 (00 hex)

DDS-3: Continuous series of 00110010 (4C hex)

DDS-4: Continuous series of 01000000 (02 hex)

> **Note**
> DDS-4 is identical to the 1/8 pattern

These preprogrammed test sequences may also be sent framed or unframed. The leftmost and the middle softkeys in screen [13] are used to make this selection.

Screen [14]

```
This Pattern WILL
cause LOS w/o B8ZS
```

DDS-1 and DDS-2 contain long strings of zeros. Their transmission will cause loss of signal (LOS) if either one is selected and the transmitter is set to send an AMI formatted signal. If either DDS-1 or DDS-2 are selected and the DS1 TRANSMIT is not set for B8ZS, the VFDT will display screen [14] for 4 seconds.

Screen [15]

```
1/1       1/8   3/24    QRS
CHAN            UFR   FR   NXT
                      #    #    #
```

Depressing the NXT softkey in screen [13] returns the VFDT to the first DS1 PATT screen [1] (shown here as screen [15]).

### 5.2.3 FRAMING AND CLOCK SOURCE

The FRAME & CLK SRC key/menu allows you to select the framing format for the pattern delivered by the DS1 transmitter. It also provides for selecting the clock source. Depressing the FRAME & CLK SRC key causes the LED in this key to take the FLOSO state and the VFDT to display a screen similar to screen [16].

Screen [16]

```
FRAME TYPE  CLOCK  SRC
        D3/D4  ESF  SLC
         #     #    #
```

Screen [17]

```
FRAME TYPE  CLOCK  SRC
          RCVR  INT  EXT
           #     #    #
```

The underline on the top line can be changed to CLOCK SRC by depressing either pointer keys. When this is done, screen [17] is displayed instead.

When screen [16] is displayed, the softkeys allow you to select the D3/D4, ESF and SLC framing format respectively. The current selection is underlined. The D3/D4 format is the standard sequence used in channel banks; it is also used by shelves B, C and D in SLC-96 systems. The ESF (Extended Superframe) format is used in more recent systems. The SLC header refers to the framing format used by shelf A in SLC-96 systems.

Remarks:

**The ESF format** includes a 4 kb/s data link. Unless the YEL alarm is being sent, the message sent on this data link consists of an uninterrupted sequence of 1's.

**The SLC-96 format** includes a 2333 b/s data link. The message sent on this link consists of the repeating bit sequence:

| Field Name: | ccccccccccc | mmm | aa | ssss |
|---|---|---|---|---|
| Tens: | 00000000011 | 000 | 00 | 0000 |
| Units: | 12345678901 | 123 | 12 | 1234 |
| Bits: | 11111110000 | 111 | 11 | 1111 |
| Note: | c = Concentrator Field, m = Maintenance, a = Alarm and s = Switch | | | |

The framing selection is only effective when the DS1 Transmit section delivers an internally generated, framed pattern. The framing selection of a signal applied to the AUX. DS1 input cannot be modified by the DS1 transmitter circuitry. Similarly, the framing selection of a signal applied to the diagnostics receiver while the 235A is in loop mode may not be modified by the DS1 transmitter.

When screen [17] is displayed, you can select the clock source used by the DS1 transmitter. The EXT softkey header appears only if a clock is externally supplied at J14 pin 25. (This 25 pin connector is located on the right hand side of the instrument.) If the transmitter must use its master clock, the INT header must be underlined. Alternatively, the EXTernally supplied clock source may be used or the transmitter can use the clock recovered from the bit stream applied to the DS1 Receive Diagnostics section.

**Remark:**
The externally supplied clock may be obtained from the DS1 REF receiver. In this case, a jumper is needed for connecting J14 pin 25 with pin 13. If you intend to use this feature, it is suggested to use a male 25 pin connector having pins 13 and 25 connected together.

### 5.2.4 LINE FORMAT SELECTION

The format of the signal delivered at the T1 and the MON jack can be set to AMI (alternate mark inverted) or B8ZS (bipolar 8-zero suppressed) when the pattern is internally generated or derived from the signal applied at the AUX. DS1 jack. Successive depressions of the FORMAT key toggle the selection as indicated by the two LED's next to the key.

When the LOOP MODE prevails (as described in section 5.6) the line format is controlled by the DS1 Receive Diagnostics section to ensure format consistency. In this case, the FORMAT key is ineffective.

### 5.2.5 OUTPUT LEVEL SELECTION

The level of the PCM bit stream at the OUTPUT T1 jack can be set to 0, -7.5, or -15 dBDSX with the 3-position OUTPUT LEVEL rocker switch. The -7.5 dBDSX and -15 dBDSX settings yield respectively the nominal (0 dBDSX) signal attenuated by a 7.5 or 15 dB artificial line. This has the same characteristics as a AWG #22 PIC cable pair exhibiting a loss of 7.5 or 15 dB at 772 kHz.

When terminated with a 100 Ohm resistive load, the signal at the OUTPUT MON jack is 20 dB below that at the OUTPUT T1 jack

## 5.3 SENDING THE YELLOW ALARM

When the DS1 Transmit section delivers an internally generated framed bit stream, a yellow alarm can be inserted in this stream. The alarm is inserted while the YEL ALARM key is lit. Repeated depressions of this key cause the selection to toggle on and off.

The yellow alarm code differs according to the framing mode selection. When this selection is SF or SLC-96, the code consists in forcing bit 2 in every channel to zero. When the system selection is ESF, the code consists of a sequence of eight consecutive 'one' bits followed by eight consecutive 'zero' bits carried by the data link.

The yellow alarm can be introduced only when DS1 patterns are generated by the Transmit section. It is suggested that yellow alarm not be generated with 1/8 and SF or SLC-96, as this causes a LOS.

## 5.4 SIMULATING ERRORS

Screen [18]

```
BPV BIT CRC FR      3E-4
  3          GO 1X RATE
             #  #    #
```

When the ERROR INJECT key in the DS1 Transmit section is depressed, the VFDT displays the impairment menu. Some of the selections of this menu may be blanked-out as they may not apply to the type of pattern being generated by the 235A. The full menu is shown as screen [18].

The BPV selection allows the introduction of bipolar violations. The BIT selection allows the introduction of bit errors. This selection is not applicable when the selected DS1 bit pattern is CHAN. The CRC selection is applicable only when the selected DS1 bit pattern is framed with ESF format; it permits the introduction of an error in the 6 bit CRC value. Finally, the FRAME selection causes the introduction of Ft frame bit errors only; this selection applies only when the selected bit pattern is framed.

The current selection is underlined. To activate the selection you may either depress the 1X softkey to inject a single error per depression or depress the GO softkey to introduce the errors at the rate listed in the upper right hand corner of the screen ($3x10^{-4}$). While the impairment is being introduced at the specified rate, the GO softkey header is replaced by the flashing STOP header and the underline for the active selection is flashing on and off. To stop the error injection depress the STOP softkey.

**Note**
If you are injecting single errors while doing Fractional T1 testing, the error may not be detected by the 235A since errors are injected in the full DS1. For example, if you are only transmitting a pattern in one channel, and you inject a single error, there is a one in twenty four chance that the error will be detected (i.e. that it will be injected in the active DS0). Option 03A must be installed to do F-T1 testing.

The number in the lower left hand corner of the ERROR INJECT screen is the number of accumulated errors associated with the selected error type (i.e. in screen [10] three BPVs have occurred during the test period). If the underline is moved to BIT, the VFDT will display the number of bit errors since the last RESTART. This feature allows you to see the errors accumulate as you inject them. A flashing F next to the error count indicates that the count was frozen due to removal of the patchcord. A flashing T next to the error count indicates that the test time has expired.

Screen [19]

| | | | | |
|---|---|---|---|---|
| ERROR RATE | $\underline{3}x10^{-4}$ | UP | DN | ENTR |
| | | # | # | # |

To change the error injection rate, depress the RATE softkey in screen [18]; this causes the VFDT to display a screen similar to screen [19].

Both the mantissa (3) and the exponent (4) can be changed by moving the underline as required using either pointer keys and pressing the UP or DN softkeys to increment or decrement these values. The error rate can be set in the range $1x10^{-9}$ (1 error in $10^9$ bits) to $9x10^{-3}$ (9 errors in 1000 bits) errors per bit. By depressing the ENTR softkey, screen [18] is displayed anew with the updated rate.

**Remark:**
When the DS1 Transmit operates in the LOOP MODE or when the bit stream delivered by the 235A is obtained from a DS1 stream supplied to the AUX. DS1 input, only BPV's can be introduced in the bit stream.

## 5.5 GENERATING LOOP CODES

The 235A can be set up to send loop-up and loop-down codes suitable for controlling CSU's (customer service units), NI's (network interfaces) as well as other remote looping devices. When depressing the LOOP UP key, the VFDT displays the loop-up code selection menu shown as screen [20].

Screen [20]

```
LOOP    CSU      1100101
UP      NI    UFR EDIT GO
              #   #    #
```

Either pointer key can be depressed to change the underline to the NI, the CSU or the user selected loop code (1100101 in the present case). When the left-most softkey header reads UFR the selected loop-up code is unframed. Depressing this key causes its header to read FR and the loop code to be framed.

The selected LOOP UP code is sent when the GO softkey is depressed and times out five seconds after the key is released. When depressing the EDIT key, the VFDT displays a screen similar to screen [21] to allow you to change the repeating bit sequence. This sequence can have any combination of ones and zeros. Its length is in the range of one to eight bits.

Screen [21]

```
LOOP-UP      1100101
CODE       BLNK ENTR
                #    #
```

In screen [21], you use the 1 and 0 keys to enter your loop-up code. The BLNK softkey is used to enter codes with fewer than eight bits. When you press it, the bit position above and all of the bit positions to the right of the cursor are blanked. Pressing the ENTR softkey stores the code and returns screen [20] with the updated code to the VFDT.

The loop-down code is entered and stored from the LOOP DOWN menu in the same manner as the loop-up code.

> **Note**
> When the 235A is in the ESF framing format, and an unframed CSU Loop Down code is sent to the 235A, it may not recognize the code since it looks like an ESF framed signal with frame bit and CRC errors.

## 5.6 LOOP MODE OPERATION

When the DS1 transmitter is placed in the LOOP MODE, the T1 output stream is a replica of the PCM signal applied to the DS1 RECEIVE DIAGNOSTIC section. Entry and exit from the loop mode is accomplished manually by using the LOOP MODE key; an automatic selection is also possible as described below. The loop mode prevails when the LOOP MODE key is in the FLOSO state. The VFDT then displays screen [22].

Screen [22]

```
The T1 output stream
is now = to PCM in
```

While the loop mode is active, you cannot send the yellow alarm, or any loop codes. You can however inject BPV's by accessing the ERR menu or by setting the output level with the rocker switch.

To exit the loop mode depress the LOOP MODE key. The 235A will return to the last mode of operation before entering loop mode, either the DS1 or F-T1 testing mode.

**- Automatic loop mode entry/exit**

If the diagnostics receiver recognizes a CSU or NI loop code, or your defined loop code, and Auto-loop is active (DIP switch S2/6 is ON) the 235A loops up or down accordingly after 1 second. When it loops up, the DS1 PATT key is turned off, the LOOP MODE key lights steadily, and screen [23] is displayed, as long as the loop code is being received, to let you know that the loop was caused by a received code.

Screen [23]

```
RECEIVING CSU
     LOOP UP CODE
```

# CHAPTER 6
## PERFORMING OUT-OF-SERVICE TESTS

### 6.1 INTRODUCTION

The out-of-service testing capability provided by the 235A is primarily intended to characterize the transmission integrity of a facility. This instrument includes a number of features to :

- loop and unloop the remote end of a facility.
- perform bit error rate testing.
- manually stress test a line equipped with repeaters.
- measure the DS1 level and frequency.
- measure the span line DC current.
- identify the presence of bridge taps (option 05).
- automatically stress test a facility (option 05).
- stress test a facility using long test patterns (option 03 or 03A).
- test a fractional T1 transmission network (with option 03 or 03A).

In this chapter, you will find test set-up and application information for all these features as well as general information about the principles of Out-Of-Service (OOS) Tests.

To avoid repeating set up information, you are referred to Chapter 4 for setting up the DS1 monitoring, and Chapter 5 for DS1 pattern generation.

### 6.2 OUT-OF-SERVICE TESTING PRINCIPLES

Performing the tests described in this chapter on a transmission facility while it is placed out-of-service yields dependable and quick results. The purpose of these tests is to characterize the suitability of any facility to carry PCM traffic. To this end, the facility transmission performance is primarily evaluated under various conditions simulating real traffic. Other tests may be used for stressing line repeaters and for determining the presence of bridge taps on a line (if option 05 is installed).

The purpose of this section is to discuss the principles on which these tests are based. These tests may be performed either in a straight-away basis as illustrated in Figure 6.1, or they can be carried out in a looped mode by looping the far end of the facility with a patch cord or a remote looping device as illustrated in Figure 6.2.

Since the 235A combines a transmitter with a receiver, looped tests can be performed using a single instrument.

**Bit Error Detection**
Regardless of the testing configuration, the PCM monitor circuit detects errors by comparing on a bit-by-bit basis the monitored pattern with an exact copy of the signal delivered by the sender to the facility. This copy is created by a generator similar to the one used by the sender. This generator is synchronized with the monitored pattern to ensure proper phase relationship since an exact phase relationship is required to obtain a meaningful bit-by-bit comparison.

Upon achieving pattern synchronization, bit errors are detected and accumulated. They may be processed further to yield errored seconds, percent error free seconds (%EFS), average bit error rate (BER), as well as other accepted characterizations.

The measurement of the average bit error rate (BER) is obtained by calculating the ratio of the total number of bit errors detected to the total number of bits transmitted. This second number is obtained from the product of the nominal bit rate (1,544,000 bits/sec) by the number of seconds synchronized since the last test began.

Typical patterns used to simulate traffic consist of relatively random bit sequences. These sequences are generally referred to as quasi-random or pseudo-random because they have a finite length and must be repeated over time. Consequently, unlike real traffic, they are not truly random. Examples of such patterns are given in Table 6-1.

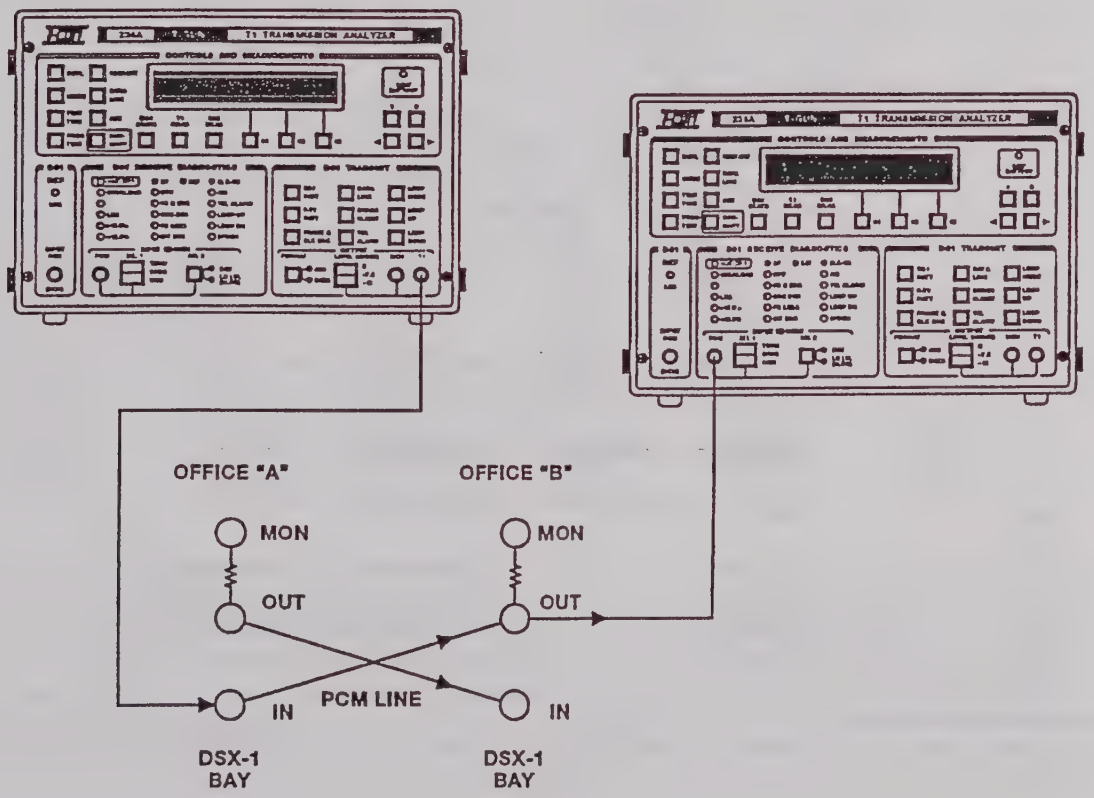



Figure 6-1 Straight Away Test Configuration

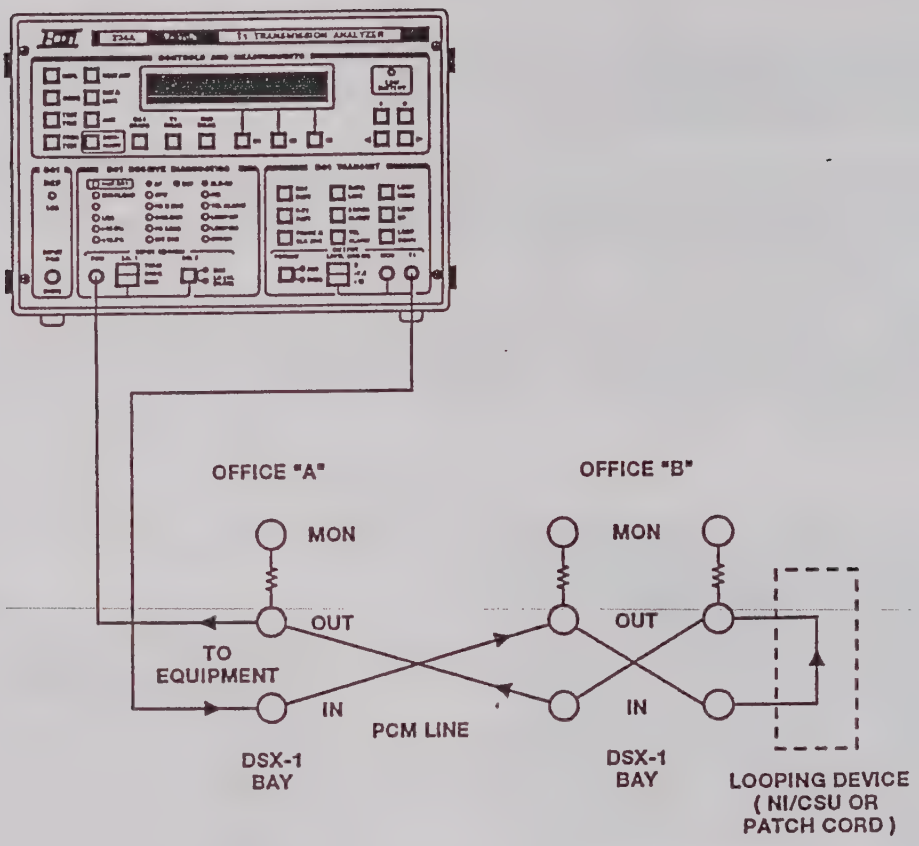



Figure 6-2 Looped Test Configuration

Table 6-1 Commonly used PRBS test patterns

| Name | Length | Comment |
|---|---|---|
| $2^{15}$-1 | 32,767 | 14 consecutive zeros maximum |
| QRS | 1,048,575 | 14 consecutive zeros maximum |
| $2^{20}$-1 | 1,048,575 | 19 consecutive zeros maximum |
| $2^{23}$-1 | 8,388,607 | 22 consecutive zeros maximum |

**Stressing line repeaters**

Line repeaters can be stressed by varying the pattern of ones and zeros over specified limits. Commonly accepted patterns suitable for this purpose include :

- 1/1 (11111111)
- 1/8 (01000000)
- 2/8 (01000010)
- 3/24 (01000100 00000000 00000100)
- QRS

As in the case previously described, the monitoring circuit performs bit-by-bit comparison with a copy of these patterns. For convenience, a program can automate the test sequence by switching automatically from one pattern to the next after a preset time has been reached. option 05 provides this capability as well as automated Bridge tap testing described below.

**Bridge tap testing**

A bridge tap on a PCM line causes energy to be reflected preferentially at some frequencies. If sufficient, this energy can impair the next repeater ability to accurately regenerate the received PCM bit stream.

Because the energy is not reflected uniformly for all frequencies across the spectrum, the identification of bridge taps requires the simulation of several frequency components. This is readily accomplished by selecting a family of test patterns. As in the case previously described, the monitoring circuit performs bit-by-bit comparison with a copy of these patterns. For convenience, a program automates the test sequence by switching automatically from one pattern to the next after a preset time has been reached. These patterns include the following:

| | | | | | | |
|---|---|---|---|---|---|---|
| 1/1 | 1111 | | | | | |
| 1:1 | 1010 | | | | | |
| 1:3 | 0100 | | | | | |
| 1:5 | 0100 | 00 | | | | |
| 1:6 | 0100 | 000 | | | | |
| 1/8 | 0100 | 0000 | | | | |
| 2:8 | 1100 | 0000 | 00 | | | |
| 2:9 | 1100 | 0000 | 000 | | | |
| 2:10 | 1100 | 0000 | 0000 | | | |
| 2:11 | 1100 | 0000 | 0000 | 0 | | |
| 2:12 | 1100 | 0000 | 0000 | 00 | | |
| 2:13 | 1100 | 0000 | 0000 | 000 | | |
| 2:14 | 1100 | 0000 | 0000 | 0000 | | |
| 3/18 | 1101 | 0000 | 0000 | 0000 | 00 | |
| 3/19 | 1100 | 1000 | 0000 | 0000 | 000 | |
| 3/20 | 1100 | 0100 | 0000 | 0000 | 0000 | |
| 3/21 | 0100 | 0100 | 0000 | 0000 | 0000 | 1 |
| 3/22 | 0100 | 0100 | 0000 | 0000 | 0000 | 10 |
| 3/23 | 0100 | 0100 | 0000 | 0000 | 0000 | 100 |
| 3/24 | 0100 | 0100 | 0000 | 0000 | 0000 | 0100 |
| QRS | $2^{20}$-1 pseudorandom pattern with 14-zero suppression | | | | | |

**Remark:**
The out-of-service testing methods described in this section are very powerful in quickly verifying that a transmission facility is suitable for carrying the intended PCM traffic. This is particularly useful when a new installation has been completed and must be verified prior to placing it into service. However, the out-of-service test method is not useful to evaluate the performance of a channel bank.

## 6.3 235A OUT-OF-SERVICE TESTING CAPABILITIES

The out-of-service test pattern sending capability is associated with the DS1 Transmit section of the 235A. This section can generate all the test patterns described in the preceding paragraphs and some additional test patterns as well : a 24-bit user-defined stress pattern and miscellaneous loop codes for controlling the remote looping feature of CSUs, NIs (network interface units) as well as other devices. Furthermore, the DS1 Transmit section has a provision for injecting various impairments in the delivered bit streams.

The bit monitoring capability is provided exclusively by the DS1 Diagnostic Receiver of the 235A. With the 235A's auto-search feature turned off, the receiver compares the monitored PCM with the pattern selected in the transmitter. When the 235A's auto-search is enabled, the receiver searches through all the patterns that the transmitter can send until it finds a match. Once the receiver is synchronized to a pattern while auto-search is turned on, it will not search for another pattern unless a RESTART command is given.

The DS1 Diagnostics Receiver displays in real time the pattern synchronization (SYNCH) and each occurrence of a transmission impairment such as bit error, BPV, etc. as noted in Table 4-1 (Chapter 4). Bit errors can be detected only while pattern synchronization prevails. A microcontroller processes the error counts and yields errored seconds as well as error rates.

When equipped with the PROGrammed TEST option 05, the 235A can automatically perform the transmission and monitoring of test patterns designed to identify the presence of bridge taps on the PCM line. It can also stress test line repeaters automatically.

When equipped with the option 03 or 03A, the 235A stress tests a transmission facility with 55-octet and other user-defined long test patterns. This option also provides for the effective testing of fractional T1 transmission facilities and networks. Chapter 9 describes this capability.

The 235A also measures the input PCM signal level, its clock rate and the span line DC current.

Finally, the built-in test timer allows you to select a test duration of up to 1000 hours with a resolution of one second, or to run a test without a time limit.

## 6.4 PROGRAM TEST CAPABILITY DESCRIPTION

Screen [1]

| BRIDGE-TAP | REPEATER |
|---|---|
| REVIEW | 1X GO |
| # | # # |

The programmed test capability is provided by the 235A when it is equipped with option 05. It is accessed by depressing the PROG TEST key in the CONTROL AND MEASUREMENTS section. If no programmed tests are being carried-out, depressing this key causes the VFDT to display a screen similar to screen [1].

The underlined header on the top line in screen [1] identifies the current test selection. The underline is moved by depressing either arrow keys. The header for the leftmost softkey reads REVIEW only if the test has been previously run and results are available; otherwise it is blanked-out. Depressing this softkey when its header is REVIEW causes the VFDT to display the results of the selected programmed test.

When the header for the middle softkey reads 1X, the depression of this key causes the header to change to CONT and vice versa. When CONT is displayed, the programmed test sequence will be repeated continuously and results recorded for the duration of the test time. When the header reads 1X, the selected programmed test sequence is performed only once.

When the header for the rightmost softkey reads GO, the test is ready to be started. The depression of this key causes the test to start, a reset to be performed and the header to be changed to STOP. When the header reads STOP, depressing this key causes the test to be stopped and the VFDT to display the results of the test.

Screen [2]

```
BRDG-TAP              0 ERRS
(1/1)          EXIT PRV NXT
                #   #   #
```

Screen [2] gives an example of such results. While a programmed test is in progress, the screen is continuously updated to keep you informed of the proceedings.

Screen [3]

```
REPEATER  TEST  (1/1)
(0:34)    REVIEW    STOP
                #       #
```

For example screen [3] indicates that the REPEATER stress test is being carried out with the all-ones code and that this code will continue to be sent for another 34 seconds before switching to the next one.

Screen [4]

```
BRDG-TAP  TEST  (1:5)
 (17)     REVIEW    STOP
                #       #
```

Similarly, screen [4] indicates that the BRDG-TAP TEST is now being carried out with the 1:5 code (100000) and that this code will continue to be sent for 17 seconds before switching to the next one.

Remarks:
As patterns are being switched, a one-second transition code is being sent to alert the receiver to seek synchronization with the next code in the sequence. This transition code is displayed as RPTR or BRDG respectively in screens [3] and [4] in the time field.

- When the transmitter has completed the sending of a test sequence ahead of the receiver, the RCVR header is displayed in the time field.

- The test patterns may be either framed or unframed according to the selection made for the pattern generated by the DS1 transmitter just PRIOR to entering the PROG TEST selection. For example, if that selection was framed with the ESF format, the programmed tests use a sequence of patterns framed with this format.

**Obtaining test results**

Test results may be obtained while a test is in progress, upon stopping the test manually or automatically when the test sequence is completed.

**-Displaying test results during the test**

To display test results while the test is taking place, depress the REVIEW softkey in screens [3] or [4]. The depression of this key in screen [4] causes the VFDT to display a screen similar to screen [5].

Screen [5]

```
BRDG-TAP              0 ERRS
(1:5)          EXIT PRV NXT
                #   #   #
```

This screen indicates that no errors have been recorded in the 1:5 pattern. Depressing the middle softkey in this screen yields the results obtained with the preceding pattern as illustrated by screen [6].

Screen [6]

```
BRDG-TAP      34567 ERRS
(1:3)     EXIT PRV NXT
                # #   #
```

Screen [7]

```
BRDG-TAP      NO SYNC
(1:6)     EXIT PRV NXT
                # #   #
```

Screen [8]

```
BRDG-TAP            3 SLS
(QRS)     EXIT PRV NXT
                # #   #
```

Screen [6] reveals that when the 1:3 code was run, 34567 bit errors were detected. Depressing softkey #3 in screen [6] causes the VFDT to display screen [5] again. Repeated depressions of softkeys #2 and #3 allow you to check the content of the error count associated with each test pattern. If you are reviewing an error counter before the test has been performed with the corresponding pattern, NO SYNC is displayed in lieu of the error count as shown in screen [7]. When the test is completed, this screen is updated, unless synchronization was not acquired for that pattern. If synchronization for a pattern is acquired, but sync loss occurs, a screen like screen [8] will be displayed.

If the test sequence is not completed, depressing the EXIT softkey in screens [5], [6] , [7] or [8], causes the VFDT to display a screen similar to screen [4]. If the test sequence is completed, depressing the EXIT softkey in screens [5], [6] , [7] or [8] causes the VFDT to display a screen similar to screen [1].

**-Displaying test results upon stopping the test sequence**
As noted above, when depressing the STOP softkey, in screens [3] or [4] as an example, the test sequence is stopped and the error count obtained is displayed by the VFDT as in screen [2].

**-Displaying test results upon completing the test sequence**
When the BRDG-TAP test sequence has been completed, by both the receiver and the transmitter, and the test is set for 1X, the 235A will automatically go into the test reviewing screens. If no errors occurred during the test, screen [9] will be displayed; otherwise, a screen like [5], [6], [7], or [8] will be displayed.

Screen [9]

```
BRDG-TAP TEST -     NO
ERRORS FOUND!     EXIT
                      #
```

Depressing the EXIT softkey in screen [9] causes the VFDT to display screen [1] again.

## 6.5 SETTING-UP THE 235A FOR OUT-OF-SERVICE TESTING

To perform out-of-service testing, you can use the 235A to send test patterns, to monitor them or to perform both functions at the same time. Figure 6-2 shows the typical test set-up applicable to all the procedures given below. A 235A equipped with option 05 is required to carry out procedures 6.6.11 and 6.6.12. A 235A equipped with option 03 or 03A is required to carry-out procedures 6.6.13 and 6.6.14.

The OUTPUT T1 jack of the 235A is patched to the XMT side of the facility, the facility is looped at the far end with a patch cord or by a looping device controlled with a loop code sent from the 235A, and the RCV side of the facility is patched to the INPUT PCM jack of the analyzer. A patch cord from

the DS1 Transmit OUTPUT MON jack to the DS1 REF INPUT PCM jack of the analyzer is made to permit slippage measurements of the transmission facility.

To obtain a printed record of the result of each test the 235A must be equipped with option 02 and a compatible printer must be connected to the RS-232-C Port. Chapter 12 in this manual provides additional information with respect to the RS-232-C port.

## 6.6 GENERAL TEST PROCEDURES FOR OUT-OF-SERVICE TESTING

A set of general procedures for setting up the 235A to test a facility is given below.

### 6.6.1 Setting the Test Time

1. Access the TEST TIME menu and if the limit is to be changed, depress the SET soft key.
2. Set the desired test time using the UP and DN softkeys and depress the GO softkey to store the value (this also initiates the test sequence).

### 6.6.2 Looping the Facility at the Far End

1. Set the output level as appropriate (0 dBDSX if patched at the DSX bay).
2. Depress the LOOP UP key to let the VFDT display the loop-up menu.
3. Make the appropriate code selection (CSU, NI or user defined).
4. Depress and release the GO softkey. The selected loop-up code is sent while the GO key is depressed and for five seconds following its release.
5. When the remote unit "loops", it will return the loop up code, which will be indicated by the receiver diagnostics section.

### 6.6.3 Unlooping the Facility at the Far End

1. Set the output level as appropriate (0 dBDSX if patched at the DSX bay).
2. Depress the LOOP DOWN key to let the VFDT display the loop-down menu.
3. Make the appropriate code selection (CSU, NI or user defined).
4. Depress and release the GO softkey. The selected loop-down code is sent while the GO key is depressed and for five seconds following its release.

### 6.6.4 Sending a Test Pattern

1. Set the output level as appropriate (0 dBDSX if patched at the DSX bay).
2. Select the clock source from the FRAME & CLK SRC menu.
3. Select the desired test pattern from the DS1 PATT menu.
4. Select the framing format (if the test pattern is framed) using the FRAME & CLK SRC menu.
5. Select the output format (AMI/B8ZS) as required.

### 6.6.5 Injecting Impairments

1. Select the type of error from the ERROR INJECT menu.
2. Select the error rate from the RATE sub-menu if applicable.
3. Depress the 1X (single event) softkey to introduce single events or the GO softkey to inject the impairment at the selected rate.

### 6.6.6 Monitoring the Bit Stream

1. Set the input level selection SEL 1 and SEL 2 as appropriate.
2. RESTART the test set to clear the counters, initiate the start of the test timer and acquire pattern synchronization.
3. Read-out the DS1 impairment statistics using the DS1 STATS menu.

### 6.6.7 Observing Slippage

1. Access the slippage screen by depressing the T1 MEAS key and the NXT softkey.

### 6.6.8 Measuring the DS1 Level and Frequency

1. Access the level and frequency measurements by depressing the T1 MEAS key.

### 6.6.9 Manually Stressing a Line Equipped with Repeaters

1. Loop the facility at the remote site using a patch cord or by sending a loop code to the far end looping unit.
2. Set the transmitter to send the 1/1, framed or unframed test pattern.
3. Set the DS1 receiver SEL 1 and SEL 2 as required to obtain a meaningful measurement.
4. Set the TEST TIMER and start the test sequence.
5. At the end of the test time, read and/or record the impairment statistics.
6. Repeat steps 2 to 5 with the 1/8 test pattern.
7. Repeat steps 2 to 5 with the 3/24 test pattern.
8. Repeat steps 2 to 5 with the QRS test pattern.
9. Repeat steps 2 to 5 with other user-defined test patterns if desired.
10. Unloop the facility by removing the patch cord at the far end or by sending the appropriate loop down code to the looping unit.
11. Interpret the obtained test results.

### 6.6.10 Measuring the Span Line DC Current

1. Access the span line current measurement by depressing the LINE mA key.

### 6.6.11 Automatically Stressing a Line Equipped with Repeaters (option 05 is required.)

1. Loop the facility at the remote site using a patch cord or by sending a loop code to the far end looping unit.
2. Select the RPTR TEST from the PROG TEST menu.
3. Run this program by depressing the GO softkey
4. Upon completion, access the REVIEW screen by depressing the REVIEW softkey
5. Interpret the results as follows : - If NO ERRORS FOUND => The line is in fine shape

   - if errors in significant quantity have occurred, you may need to isolate the site of the marginal or defective line repeater.
6. Unloop the facility by removing the patch cord at the far end or by sending the appropriate loop down code to the looping unit.

### 6.6.12 Identifying Bridge Taps (option 05 is required)

1. Loop the facility at the far end with either a patch cord or by sending to the loop-up code to the far end looping unit.
2. Select the BRDG TAP test from the PROG TEST menu.
3. Run this program by depressing the GO softkey
4. Upon completion, access the REVIEW screen by depressing the REVIEW softkey
5. Interpret the results as follows : - If NO ERRORS FOUND => there are no bridge taps. - If errors occur selectively for some test patterns but not for others, there is a probability that a bridge tap exists somewhere along the span line.
6. Unloop the facility by removing the patch cord at the far end or by sending the appropriate loop down code to the looping unit.
7. Identify the location of the bridge tap, if any, by carrying out a binary search along the span line.

### 6.6.13 Stressing a Facility Using Long Test Patterns (option 03 or 03A is required)

1. Loop the facility at the far end with either a patch cord or by sending to the loop-up code to the far end looping unit.
2. Select the desired Long Test Pattern from the DS1 PATT menu. See Chapter 5 for details.
3. Transmit the selected pattern for a desired length of time. See Chapter 5 for details.
4. Check for errors by using the SUMMARY key or DS1 PATT key as described in Chapter 4.

### 6.6.14 Testing a Fractional T1 Transmission Facility (option 03 or 03A is required)

1. Loop the far end using a patch cord or set up another 235A at the far end.
2. Configure the 235A for 64*N or 56*N fractional T1 testing and for the appropriate channels to be tested using the F-T1 PATT key. (See Chapter 8 for details)
3. Select the desired pattern for stress testing using the PAT softkey (See Chapter 5) and transmit for a desired length of time.
4. Check for errors by using the SUMMARY key or DS1 STAT key as described in Chapter 4.

# CHAPTER 7
## OBTAINING DS0 CHANNEL BASED MEASUREMENTS

### 7.1 INTRODUCTION

The information contained in this chapter applies specifically to the capabilities provided by the 54B DS0 Channel Monitor add-on unit. If your 235A is not equipped with one of these units, the measurement capabilities described in this section are not available.

When the 235A is equipped with the 54B, you can select any one of the 24 DS0 channels in the monitored DS1 bit stream and obtain several measurements performed on the signal carried by this channel.

The 54B DS0 channel capabilities include:

- display and analysis of bit patterns
- display in real time of the signaling states
- measurement of VF signal level and frequency
- noise level measurement with several weighting filters
- VF signal reproduction (speaker)
- VF signal access (jack) for further signal processing
- displays signaling states in all 24 DS0 channels simultaneously

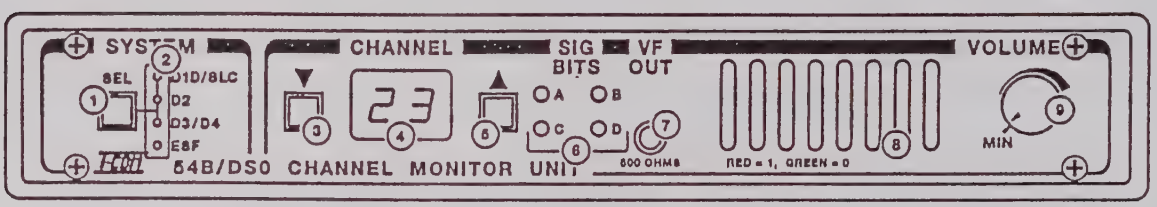



Figure 7-1 54B DS0 Channel Access Front Panel

The paragraphs on the following pages provide a detailed description of these capabilities as well as some practical applications.

### 7.2 FRONT PANEL DESCRIPTION

The 54B front panel is shown in Figure 7-1.

The front panel feature description on the following page refers to the corresponding numbers in Figure 7.1.

1 **SEL** -- This key is used whenever the system format selection must be changed. Each depression of the key causes the selection indicated by one of the LEDs (2) to change to the next one below. When the current selection is D3/D4 and the key is depressed, the next selection is D1D/SLC.

2 **D1D/SLC, D2, D3/D4, ESF** -- Only one of these LEDs is lit at any time to indicate the current system format selection.

3 **DOWN** -- Each depression of this key causes the DS0 channel number displayed by the two-digit LED display to be decremented by one count. Holding down the key causes decrementing at a rate of three counts per second.

4 **CHANNEL** -- This two-digit LED display shows the selected DS0 channel number being monitored (range 1-24). When framing is lost by the 235A, the LED display reads "F.L."

5 **UP** -- Each depression of this key causes the channel number displayed by the two-digit LED display to be incremented by one count. Holding down the key causes the incrementing at a rate of three counts per second.

6 **A-B-C-D SIG BITS** -- These 4 bi-color LEDs display the signaling states associated with the selected DS0 channel. The red colored light corresponds to state "1" and the green colored light corresponds to state "0". Signaling bits C and D are lit only when the ESF format is detected. All signaling bits are turned off when framing is lost by the 235A.

7 **VF OUTPUT** -- This jack supplies the reconstructed VF signal found in the selected DS0 channel. The level of this output is normalized such that 0 dBm = 0 dBm0 across a 600-ohm load.

8 **Speaker** -- The reconstructed VF signal in the selected DS0 channel is amplified and applied to this speaker.

9 **VOLUME** -- This control adjusts the sound volume heard from the loudspeaker (8). When the knob is rotated fully counterclockwise (MIN position) the speaker is turned off.

## 7.3 SETTING-UP AND INITIALIZING THE 54B

Upon powering the 235A, the DS0 Channel Monitor Unit is also powered up and the self-test sequence is initiated. When the self-test passes the unit is ready for use.

To monitor or to measure the signal contained in a DS0 channel, a framed DS1 bit stream must be presented to the PCM INPUT jack of the 235A DS1 RECEIVE DIAGNOSTICS section. Input configuration switches SEL 1 and SEL 2 must be set appropriately. The DS0 Channel Monitor Unit SYSTEM selection is set automatically by the 235A as follows :

| **235A framing** | **54B selection** |
|---|---|
| ESF | ESF |
| SLC-96 | D1D/SLC (default) |
| SF | D3/D4 (default) |

Because the DS1 bit stream generated by D1D, D2 or D3/D4 channel banks share the same framing format, the DS0 Channel Monitor Unit cannot determine which of these banks is used. This selection, if different from the default, must be entered by depressing the SYSTEM SEL key as required. The SLC-96 default is D1D. D3/D4 can be selected by depressing the SYSTEM SEL key.

To change the DS0 channel number selection, depress either the UP or DOWN keys near the CHANNEL window as required. To access the DS0 screens, depress the DS0 MEAS key in the Control and Measurements section of the 235A.

## 7.4 DS0 CHANNEL CONTENT MONITORING

When the selected DS0 channel contains an encoded VF signal and signaling states, the 54B will reconstruct the VF signal and deliver a copy of it to the VF OUT jack and to the loudspeaker. The signaling bits for the DS0 channel are displayed in real-time by the signaling LEDS.

When the system format selection is ESF, all four signaling LEDs are used and represent the states for the A, B, C, D signaling bits. When any other system framing format is selected, only the A and B LEDs are lit. The loss of framing causes all four LEDs to be turned off.

The VF signal at the output jack allows you to perform measurements on the signal with auxiliary instrumentation. The speaker enables you to identify the nature of the signal and to determine its quality.

## 7.5 DS0 CHANNEL BASED MEASUREMENTS

The 64 kb/s signal in the selected DS0 channel is also processed by a built-in transmission measuring set (TMS). The TMS uses a digital signal processor to measure all VF parameters directly from the 64 kb/s bit stream.

In addition to providing unsurpassed measurement accuracy and stability over time, this technique makes it possible to measure any code offset introduced by a misaligned VF encoder circuit.

The measurements performed by the TMS include:

- averaging the one/zero bit density signal level (RMS)
- signal frequency
- code offset
- noise level with C-message filter and 1010 notch filter
- noise level with C-message only
- noise level with a 35 Hz high-pass filter

To select a DS0 measurement and to display the results, depress the DS0 MEAS key, located to the right of the T1 MEAS key, in the 235A Control and Measurements section.

Screen [1]

```
DS0 MEASUREMENTS
              DATA  VF  SIG
                    #   #   #
```

The first screen displayed upon accessing DS0 measurements for the first time since power up is similar to screen [1] if your 235A is equipped with a 54B.

These selections are associated with the 54B and may be chosen by using the arrow keys. Each selection is described in the following pages.

Screen [2]

```
BITS:   12345678
  Calculating          NXT
                       #
```

Depressing the DATA softkey yields screen [2].

If the 235A DS1 Receiver FR LOSS LED is off, and the NXT softkey is not depressed, a screen similar to screen [3] replaces screen [2] after 1 or 2 seconds.

Screen [3]

```
BITS:   12345678
        =---=---   NXT
                   #
```

In screen [3], the headings 1 through 8 indicate the respective bit positions. If a bit is continuously set at state one, a full height stack (7 rows) of horizontal lines is displayed for this bit. If a bit is continuously set at state zero, the stack is empty. If the state of a bit is one, 30% of the time , the stack has about 2 lines (7 lines x 0.33). When monitoring real DDS data traffic, it is common to have bit 1 through bit 7 represented by a half height stack and bit 8 by a full height stack. When monitoring data test codes, the display consists of a sequence of full and empty stacks as well as the identification of the test code as shown by screen [4] as an example.

Screen [4]

```
BITS:   12345678
DSU LP  --=-===--  NXT
                   #
```

In this case, DSU LP is the abbreviation for the DSU LOOPBACK code (00101100).

Table 7-1 below lists the codes identified by the 54B along with the displayed abbreviation.

**Table 7-1 Identified DDS Test Codes**

| CODE | DESCRIPTION | ABBREVIATION |
|---|---|---|
| 01111110 | IDLE CODE | IDLE |
| 11111110 | IDLE CODE | IDLE |
| 00101100 | DSU LOOPBACK | DSU LP |
| 00101000 | CHANNEL LOOPBACK | CHAN LP |
| 00101010 | OCU LOOPBACK | OCU LP |
| 00011010 | MUX OUT OF SYNC | MUX OOS |
| 00011100 | TEST CODE | TST CDE |
| 00011000 | UNASGN MUX CHANNEL | USGN CH |

Depressing the NXT softkey in any of the previous screens returns you to screen [1].

Screen [5]

```
dBm0  Hz      OFFSET
-20.0 1005      OK  NXT
                  #
```

By depressing VF in screen [1], screen [5] is displayed if the VF signal in the selected DS0 channel is an offset-free single tone of 20 dBm0 at 1005 Hz.

Additional information on the measurements given in screen [5] is given below.

- **VF LEVEL MEASUREMENT**

This measurement has a range of +3.2 to -59.9 dBm0. The unit is based on the definition of the dBm (1mW dissipated by a 600 Ohm resistor corresponds to 0.775 VRMS and is referred to as 0 dBm). When the encoded VF signal is clipped as a result of overload of the encoder, the displayed measurement value reads 'OVERLOAD'. When the encoded VF signal is less than -59.9 dBm0, the measurement value reads '<-60'.

- VF TONE FREQUENCY MEASUREMENT

This measurement capability has a range of 50 Hz to 3990 Hz. This range is limited by the 4000 Hz DS0 bandwidth. To ensure accuracy of the measurement in the presence of noise, the frequency is only measured when the level is greater than -40 dBm0. If this is not the case, the frequency reading is replaced by '****'.

- OFFSET MEASUREMENT

This measurement characterizes the algebraic difference over time between the sum of all positive samples and the sum of all negative samples. When this difference divided by the number of samples exceeds 12 counts, the offset reading given by the screen is '>12', otherwise, the offset reads 'OK'. Under normal conditions this offset is only a few counts on a scale of 8,031 counts.

All measurement values are updated at the rate of one update/two seconds. Depressing the NXT softkey in screen [5] yields a screen similar to screen [6]. This screen yields the measure of the noise after it has been filtered by a C-message filter exhibiting a notch at 1010 Hz. The measurement is also performed without the notch and is displayed by screen [7] upon depressing the NXT softkey in screen [6].

Screen [6]

```
NOISE C-MSG W/NOTCH
  34.8 dBrnCO        NXT
                      #
```

Screen [7]

```
NOISE C-MSG
  69.9 dBrnCO        NXT
                      #
```

In screens [6] and [7], the noise level measurement is expressed in dBrnC0. The measurements expressed in dBrn0 differs from the values obtained in dBm0 units by 90 dB; that is:

$$\#\ dBrn0 = \#\ dBm0 + 90$$

The C in dBrnC0 indicates that the noise has been weighted by a C-message filter. Automatic compensation is introduced to correct the noise bandwidth lost to the notch when performing C-message with 1010 Hz notch filtered measurements. When the noise level exceeds 93.2 dBrn0/dBrnC0, the displayed value reads OVERLOAD.

Pressing the NXT softkey in screen [7] yields the noise measurement performed after the VF signal has passed through a high pass filter. This filter has a flat frequency response from 50 Hz to 4000 Hz. Its purpose is to remove any residual DC component to ensure accurate noise measurement. An example of the measurement obtained is shown by screen [8].

Screen [8]

```
NOISE W/HP FILTER
  70.0 dBrn0         NXT
                      #
```

Pressing the NXT softkey in screen [8] causes the VFDT to display screen [1] again.

If the current framing selection is not ESF, depressing the SIG softkey in screen [1] causes a screen similar to screen [9] to be displayed by the VFDT.

Screen [9]

| | |
|---|---|
| 1%%%%%%%%%%%%12 | A/B |
| 13%%%%%%%%%%%%24 | NXT |

#

In screen [9], the top row gives the instantaneous states for the A and B bits in channels 1 through 12 respectively. The bottom row does the same thing for channels 13 through 24 respectively. Each upper half character gives the state of the A bits; each lower half character gives the state of the B bits.

Pressing the NXT softkey in screen [9] causes the VFDT to display screen [1] again. If the current framing selection is ESF, depressing the SIG softkey in screen [1] causes a screen similar to screen [10] to be displayed by the VFDT.

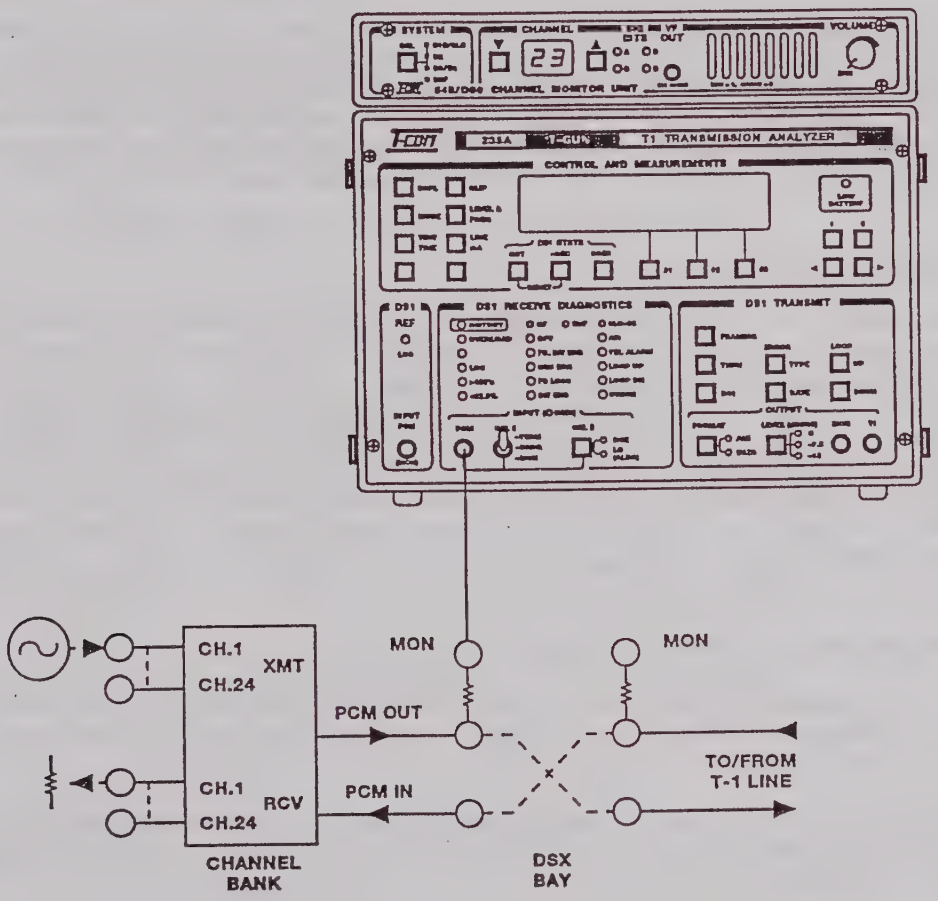



Figure 7-2 Transmit Half-Channel Gain Alignment

Screen [10]

| | |
|---|---|
| 1%%%%%%%%%%%%12 | A/B |
| 1%%%%%%%%%%%%12 | C/D |

#

In screen [10] the header for the softkey alternates between NXT and C/D. This indicates that the bottom row yields the C and D signaling states for the first 12 DS0 channels. In that row, each upper half character gives the state of the C bits; each lower half character gives the state of the D bit. Upon depressing the softkey in screen [10], a screen similar to screen [11] is displayed by the VFDT.

Screen [11]

```
13%%%%%%%%%%%%24   A/B
13%%%%%%%%%%%%24   NXT
                #    #
```

Screen [11] displays the A, B, C and D signaling states for channels 13 through 24 respectively. Depressing the softkey under '24' in this screen causes the VFDT to display the states of the A, B, C, D signaling bits for channels 1 through 12 again as in screen [10]. This softkey is not labeled.

Pressing the NXT softkey in screen [11] causes the VFDT to display screen [1] again.

## 7.6 DS0 CHANNEL VF MEASUREMENT APPLICATION INFORMATION

The transmission measurement capability provided by the 54B is quite useful for characterizing the encoder circuit performance in a number of different equipment such as channel banks, transmultiplexers, echo cancellers etc. This section describes the testing of a channel bank transmit half-channel for gain adjustment, gain linearity check, frequency response and idle noise measurements. Additional information is also provided about the code offset measurement. In this section, you will find general information applicable to most equipment used in PCM systems.

### 7.6.1 Transmit Half-Channel Gain Alignment

The transmit half-channel gain is adjusted by feeding a calibrated signal level to the input of a channel unit and measuring the encoded level directly from the PCM bit stream as illustrated in Figure 7-2. Normally, the measurement is performed at a frequency of 1004 Hz. Care must be taken so that the frequency is not precisely 1000 Hz, as this can cause erratic level readings due to the 8000 Hz sampling frequency used by the channel bank. The amplitude of the VF signal applied to the channel unit under test should be set to the value specified by the manufacturer or the company practices. Typically, this level is set to let the VF to the digital encoder yield 0 dBm0 to the DS0 channel. The gain is aligned by adjusting the transmit gain to read 0.0 dBm0 (or another recommended value) on the 235A.

### 7.6.2 Transmit Half-Channel Gain Linearity Check

The gain linearity check consists of comparing the set of measurements obtained by measuring the DS0 channel content delivered by the encoder under test with the set of signal level values sequentially applied to the channel unit VF input.

By plotting the set of input levels on one axis and plotting the set of values read on the 235A on the other axis of a rectangular coordinate system, all deviations from a line inclined by 45° illustrate the gain non-linearity for the transmit half-channel.

### 7.6.3 Transmit Half Channel Frequency Response Check

To perform this test refer to the set-up illustrated in Figure 7-2. The frequency response of the transmit half channel is obtained by plotting on a graph the level measured by the 54B TMS for each frequency of the signal applied to the channel unit VF input.

To ensure accurate results, care must be taken to keep the signal level applied to the VF input constant during the test. The resolution of the frequency response is increased by reducing the size of the frequency steps. This results in taking more measurements and requires more time.

### 7.6.4 Transmit Half-Channel Idle Noise Measurement

By still using the set-up illustrated in Figure 7-2, you can measure the transmit half-channel idle noise by setting the 235A to measure the desired type of noise and providing a quiet termination to the channel unit VF input port.

The obtained noise reading requires no correction or interpretation and can be used readily as a measure of the noise contributed by the transmit-half portion of the DS0 channel. Typically, the transmit half channel/encoder contributes the most to the overall idle channel noise.

### 7.6.5 Transmit Half-Channel Offset

Offset found in a DS0 channel is usually contributed by either an out-of-calibration or a defective VF filter/encoder circuit. The presence of offset is known to cause out-of-specification signal distortion and gain non-linearity. In addition, the operation of some echo canceller malfunctions have been traced to excessive amounts of offset.

## 7.7 DS0 SUPERVISION MONITORING APPLICATION INFORMATION

The monitoring of the supervision simultaneously in all the 24 DS0 channels of a DS1 system has several applications. The three most popular are :

- Detection of idle channels. This is useful to identify which channel can be selected for transmit half-channel testing or to subjectively gauge the traffic in a DS1 line.
- Detection of non-functional channels. These channels are either permanently idle or busy or exhibit a signaling state inconsistent with the convention for the type of channel unit used in the time slot.
- Detection of problem conditions affecting several channels. The simultaneous change of signaling state in several channels provides a useful clue to the origin of the fault.

For reference, a summary of the signaling state assignments for the most commonly used types of channel units is given in Table 7-2 and Table 7-3 in the following pages.

## Table 7-2 Channel Unit Signaling State Assignment

| CHANNEL UNIT TYPE | E&M SIGNALING CIRCUIT CONDITION TO PLR CHANNEL | TRANSMIT @ A | TRANSMIT @ B | RECEIVE @ A | RECEIVE @ B | PLR CHANNEL UNIT CONDITION TO E&M SIGNALING CIRCUIT |
|---|---|---|---|---|---|---|
| PULSE LINK REPEATER (PLR) 4W, 600Ω | E LEAD OPENED | 0 | 0 | ▪ | ▪ | ▪ |
| | E LEAD GROUNDED OR LOOPED (1) | 1 | 1 | ▪ | ▪ | ▪ |
| | ▪ | ▪ | ▪ | 0 | ▪ | M LEAD GROUNDED OR OPEN (1) |
| | ▪ | ▪ | ▪ | 1 | ▪ | M LEAD BATTERY OR LOOPED |

▪ Either State or Condition (1) Option Selected by screw switch
@ A and B Signaling Channel States are shown as they exist on the T1 line.

| CHANNEL UNIT TYPE | OFFICE CONDITION TO CHANNEL UNIT | TRANSMIT @ A | TRANSMIT @ B | RECEIVE @ A | RECEIVE @ B | CHANNEL UNIT CONDITION TO OFFICE |
|---|---|---|---|---|---|---|
| DPO XMT | LOOP OPEN | 0 | 0 | ▪ | ▪ | ▪ |
| | LOOP CLOSURE | 1 | 1 | ▪ | ▪ | ▪ |
| DPO RCV | ▪ | ▪ | ▪ | 0 | ▪ | NORMAL BATTERY |
| | ▪ | ▪ | ▪ | 1 | ▪ | REVERSE BATTERY |
| DPT XMT | NORMAL BATTERY | 0 | 0 | ▪ | ▪ | ▪ |
| | REVERSE BATTERY | 1 | 1 | ▪ | ▪ | ▪ |
| DPT RCV | ▪ | ▪ | ▪ | 0 | ▪ | LOOP OPEN |
| | ▪ | ▪ | ▪ | 1 | ▪ | LOOP CLOSURE |
| 4WE&M XMT | M-LEAD GROUNDED OR OPEN | 0 | 0 | ▪ | ▪ | ▪ |
| | M-LEAD BATTERY | 1 | 1 | ▪ | ▪ | ▪ |
| 2WE&M RCV | ▪ | ▪ | ▪ | 0 | ▪ | E-LEAD OPEN |
| | ▪ | ▪ | ▪ | 1 | ▪ | E-LEAD GROUNDED OR LOOPED |
| RPO XMT | LOOP OPEN | 0 | 0 | ▪ | ▪ | ▪ |
| | LOOP CLOSURE | 1 | 1 | ▪ | ▪ | ▪ |
| RPO RCV | ▪ | ▪ | ▪ | 0 | 1 | NORMAL BATTERY NO REVERTIVE PULSE |
| | ▪ | ▪ | ▪ | 0 | 0 | NORMAL BATTERY REVERTIVE PULSE |
| | ▪ | ▪ | ▪ | 1 | ▪ | REVERSE BATTERY NO REVERTIVE PULSE |
| RPT XMT | NORMAL BATTERY NO REVERTIVE PULSE | 0 | 1 | ▪ | ▪ | ▪ |
| | NORMAL BATTERY REVERTIVE PULSE | 0 | 0 | ▪ | ▪ | ▪ |
| | REVERSE BATTERY | 1 | 0 | ▪ | ▪ | ▪ |
| RPT RCV | ▪ | ▪ | ▪ | 0 | 0 | LOOP OPEN |
| | ▪ | ▪ | ▪ | 1 | 1 | LOOP CLOSURE |
| | ▪ | ▪ | ▪ | 0 | 1 | NOT ALLOWED |
| | ▪ | ▪ | ▪ | 1 | 0 | NOT ALLOWED |
| SDPO XMT | LOOP OPEN | 0 | 0 | ▪ | ▪ | NO SLEEVE GROUND + |
| | LOOP CLOSURE | 1 | 1 | ▪ | ▪ | SLEEVE GROUND + |
| SDPO RCV | ▪ | ▪ | ▪ | 0 | ▪ | NORMAL BATTERY |
| | ▪ | ▪ | ▪ | 1 | ▪ | REVERSE BATTERY |

@ A and B Signaling Channel States are shown as they exist on the T1 line.
▪ Any State or Condition + Either normal or reverse battery

## Table 7-3 Channel Unit Signaling State Assignment

| CHANNEL UNIT TYPE | OFFICE CONDITION TO CHANNEL UNIT | TRANSMIT @ A | TRANSMIT @ B | RECEIVE @ A | RECEIVE @ B | CHANNEL UNIT CONDITION TO OFFICE |
|---|---|---|---|---|---|---|
| FXO | NO TIP GROUND, NO RINGING | 1 | 1 | ▪ | ▪ | ▪ |
| | TIP GROUND, NO RINGING | 0 | 1 | ▪ | ▪ | ▪ |
| XMT | TIP GROUND, RINGING | 0 | 0 | ▪ | ▪ | ▪ |
| | NO TIP GROUND, RINGING | ? | ? | ▪ | 0 | (RING GROUND) |
| | NO TIP GROUND, RINGING | ? | 0 | ▪ | 1 | (NO RING GROUND) |
| | ▪ | ▪ | ▪ | 0 | 1 | LOOP OPEN, NO RING GROUND |
| | (TIP GROUND) | 0 | ▪ | 0 | 0 | LOOP OPEN, NO RING GROUND |
| | (NO TIP GROUND) | 1 | ▪ | 0 | 0 | LOOP OPEN, RING GROUND |
| RCV | ▪ | ▪ | ▪ | 1 | 1 | LOOP CLOSURE, NO RING GROUND |
| | (TIP GROUND) | 0 | ▪ | 1 | 0 | LOOP CLOSURE, NO RING GROUND |
| | (NO TIP GROUND) | 1 | ▪ | 1 | 0 | LOOP OPEN, RING GROUND |

| CHANNEL UNIT TYPE | STATION OR PBX CONDITION TO CHANNEL UNIT | TRANSMIT @ A | TRANSMIT @ B | RECEIVE @ A | RECEIVE @ B | CHANNEL UNIT CONDITION TO STATION OR PBX |
|---|---|---|---|---|---|---|
| FXS | LOOP OPEN, NO RINGING GROUND | 0 | 1 | ▪ | ▪ | ▪ |
| | LOOP OPEN, RING GROUND | 0 | 1 | 0 | ▪ | (TIP GROUND) |
| | LOOP OPEN, RING GROUND | 0 | 0 | 1 | ▪ | (NO TIP GROUND) |
| | LOOP CLOSURE, NO RING GROUND | 0 | 1 | 1 | ▪ | (NO TIP GROUND) |
| XMT | LOOP CLOSURE, NO RING GROUND | 1 | 1 | 0 | ▪ | (TIP GROUND) |
| | LOOP CLOSURE, RING GROUND | 1 | 1 | 0 | ▪ | (TIP GROUND) |
| | LOOP CLOSURE, RING GROUND | 0 | 0 | 1 | ▪ | (NO TIP GROUND) |
| | ▪ | 0 | ▪ | 1 | ▪ | NO TIP GROUND, NO RINGING |
| RCV | ▪ | ▪ | 1 | 0 | 1 | TIP GROUND, NO RINGING |
| | (LOOP CLOSURE) | 1 | 1 | 0 | 0 | TIP GROUND, NO RINGING |
| | (LOOP OPEN) | 0 | 1 | 0 | 0 | TIP GROUND, RINGING |

@ A and B Signaling Channel States are shown as they exist on the T1 line
▪ Any state or condition
? Indeterminate.
() Condition existing at distant end of VF connection for receiver
() Condition existing at distant end of overall connection for transmitter
Abnormal condition with no application.

# CHAPTER 8
## FRACTIONAL T1 TESTING

### 8.1 INTRODUCTION

The information in this chapter applies to the fractional T1 capabilities provided by the 235A when it is equipped with option 03A. If your 235A is not equipped with option 03A, the capabilities described in this section are not available.

Option 03A T1 gives the 235A the ability to perform both 56xN and 64xN fractional T1 testing, with both contiguous and noncontiguous channels.

### 8.2 FRACTIONAL T1 TESTING

The 235A transmitter and receiver can operate in either F-T1 mode or DS1 mode. To access the F-T1 mode, press the F-T1 PATT key. Entering the F-T1 mode causes screen [1] to be displayed.

Screen [1]

```
123456789¹0₁12   ch #
0̲00000000000   56K NXT
                 #   #
```

The top line of this screen represents DSO channels 1-through-12. The corresponding digit directly below this channel number indicates whether or not the channel is selected. A zero indicates that the channel is idle; a one indicates that it is active. To include a channel for fractional T1 testing, simply underline the desired channel using the arrow keys (< and >), and enter a 1. To exclude the channel, enter a zero. The left softkey header can be set to 56K or 64K by successive depressions of this key. When 56K is selected, the eighth bit of each active byte is held to a one. When 64K is selected, the full channel is loaded with the selected test pattern.

Pressing the NXT softkey in screen [1] beings up screen [2] which displays a representation of the assignment of channels 13 through 24.

Screen [2]

```
3456789²0₁1234    ch #
0̲00000000001   PAT NXT
                 #   #
```

As in screen [1], entering a 1 in any channel position causes a test pattern to be sent on that channel. The pattern will be transmitted on all channels that have been selected (have a one below them). All channels that have a zero below them contain user-defined idle code (i.e. channels 13-through-23 in screen [2]).

Depressing the NXT softkey causes the VFDT to display screen [3] which allows selection of the IDLE byte code.

Screen [3]

```
IDLE     12345678
BYTE     01000111   NXT
                     #
```

Use the arrow keys and the 1 and 0 keys to edit the idle byte. This byte of data is transmitted on all idle channels which were defined in screens [1] and [2]. These are channels 1-through-23 in the above screens. The next three screen selections allow you to select the test pattern to be transmitted in the active channel(s). The 235A does not allow all 24 channels to be idle. There must always be at least one active channel. If you attempt to enter all zeros, the following message is displayed for four seconds and the channel selection remains unchanged.

```
MUST HAVE AT LEAST
1 ACTIVE DS0
```

You can choose from three types of test patterns. These include PRBS, Long User Patterns, and four preprogrammed DDS patterns. Pressing the NXT softkey in screen [3] causes the VFDT to display a screen similar to screen [4], the PRBS pattern selection menu.

Screen [4]

```
511   2047   2^15   2^20
2^23                 NXT
                      #
```

To select a PRBS pattern for fractional T1 testing, use the arrow keys to underline the desired selection. The 2047 pattern is selected in the above screen and is sent on all the previously selected channels.

Screen [5] is displayed on the VFDT when the NXT softkey in screen [4] is depressed.

Screen [5]

```
USER-1  USER-2    USER-3
USER-4          PRV NXT
                 #   #
```

Selection of any USER-defined byte sequence causes its transmission on all the active channels. These codes may be edited as described in section 5.2.2.

When transmitting USER defined patterns over fractional T1, pattern synchronization may take up to 17 seconds. This depends on the pattern, its length and the number of channels over which the test pattern is being sent. A screen similar to screen [6] is displayed upon a USER pattern selection if the possible synchronization time is greater than 2 seconds.

Screen [6]

| |
|---|
| WARNING:THIS PAT CAN<br>TAKE 17 SECS TO SYNC |

The 17 seconds in the above screen represents the maximum possible sync acquisition time. It should not take longer than 17 seconds for synchronization to be obtained on the selected pattern.

When the 235A is in the auto-search mode, pattern synchronization may take longer since a search is done on each pattern in the transmitter's library. Therefore, the total synchronization time is the sum of all pattern search periods. The VFDT will display the message "SEARCHING" when in the SUMMARY screen while the auto-search is being carried out.

To return to screen [4], press the PRV softkey. Depressing softkey #3 causes the VFDT to display screen [7]. This menu allows the selection of the DDS patterns to be transmitted in the selected channels. These patterns are described in Chapter 5, Section 5.2.

Screen [7]

| | | |
|---|---|---|
| DDS-1 | DDS-2 | DDS-3 |
| DDS-4 | | PRV NXT |
| | # # | # |

Depress the PRV softkey to return to screen [5].
Depress the NXT softkey to return to screen [1].

**Note**

If you are injecting single errors while doing Fractional T1 testing, the error may not be detected by the 235A since errors are injected in the full DS1. For example, if you are only transmitting a pattern in one channel, and you inject a single error, there is a one in twenty four chance that the error will be detected (i.e. that it will be injected in the active DS0).

# CHAPTER 9
## SENDING AND RECEIVING ESF DATALINK MESSAGES

### 9.1 INTRODUCTION

The information in this chapter applies specifically to the capabilities afforded by option 03B. If your 235A is not equipped with this option, the capabilities described in this section are not available.

When equipped with option 03B, the 235A can access/display as well as send any of the messages carried by the ESF data link. Both AT&T and ANSI messaging schemes are supported. The 235A can also download the monitored messages to a printer via the RS-232-C port.

Before describing these capabilities in detail, some background information on both ESF transmission formats is provided.

### 9.2 ESF DATA LINK BACKGROUND INFORMATION

Since its inception in 1980, the ESF data link was dedicated to the transport of information characterizing the T1 transmission quality. By making this information available to the far end, it is possible to keep tabs on the network's operation from any location.

The characterization of the T1 transmission is based on the number of CRC errors, frame bit errors, BPV's, and controlled slips detected over time. Two distinct methods of formatting and communicating this information are defined by:

- ANSI T1.403
- AT&T publication 54016

The two schemes differ in several ways. The more significant difference is that the ANSI T1.403 approach calls for the periodic broadcast of performance messages while AT&T specifies a command/response messaging scheme. Both methods can coexist in the same data link. For a detailed and comprehensive description, the reader is referred to the two publications noted above.

#### 9.2.1 ANSI T1.403 MESSAGES

Three types of messages are defined by ANSI T1.403:

- performance report messages (PRMs)
- priority messages
- command/response messages

PRMs are broadcast once per second and consist of a sequence of bytes representing the unprocessed transmission impairment data obtained during the previous four seconds. Each PRM contains a sequence of bytes yielding raw data, status and overhead information.

Specific transmission impairment data broadcast by a sending unit include:

- CRC Error Event
- Severely Errored Framing Event
- Frame Synchronization Bit Error Event
- Line Code Violation Event
- Slip Event

Priority messages include the yellow alarm and specific codes reserved for future use.

Command and response messages include several loopback and protection switch related commands and responses. Additional codes are reserved for future use.

For convenience, priority messages and command/response messages are referred to as BOMs (Bit Oriented Messages) in this chapter as well as on various 235A screens in previous chapters.

## 9.2.2 AT&T MESSAGES

Three types of messages are defined by AT&T publication 54016:

- bit oriented messages (BOMs)
- request messages (REQs)
- response messages (RESPs)

BOMs are similar in type to the bit oriented messages specified by ANSI T1.403; however, a much more limited set of messages is supported.

REQs consist of a byte sequence specifying the type of message, the address of the originator unit, the address of the target unit, the specific command or requested data, and some overhead data. REQs are typically sent by the CO or a network element to either control the customer installation (i.e loop back) or to obtain performance reports (i.e enhanced 24-hour UAS performance report).

RESPs consist of a byte sequence specifying the type of message, the address of the originator unit, the address of the target unit, the requested impairment data or a confirmation of the command, and some overhead data. RESPs are normally sent either by a customer installation (CI) terminal (a CSU or a MUX), or by an interface unit (IU) located in the CO, in response to a REQ sent by a unit at another location. Typically, transmission performance data is collected and processed by the CSU or the IU and sent upon receipt of a request issued by a network element.

The AT&T format accounts for basic and enhanced transmission parameter responses.

Basic transmission performance messages consist of three measurements:

- Errored second counts
- Unavailable second counts
- ESF error events (CRC errors)

Enhanced transmission performance messages, now the AT&T standard, include four additional measurements:

- Severely errored second counts (SES)
- Bursty errored second counts (BES)
- Loss of frame counts (LOFC)
- Controlled slip second counts (CSS)

These seven measurements are defined as follows:

| | |
|---|---|
| ESF | single CRC errored event or an OOF event (*); accumulated a total count not related to time. |
| ES | a second with one or more CRC errored events or one or more OOFs; stored in 15 minute totals and as a rolling 24 hour summation. |
| SES | 320 CRC errors or one OOF event in a period of one second. |

UAS a period of one second during which service is not available. This state is declared when 10 consecutive SES occur.
BES a period of one second in which up to 319 CRC errors occurred.
LOFC count of the number of distinct loss of frame occurrences.
CSS a period of one second in which one or more controlled slips occurred.

(*) Out-Of-Frame condition

The above listed measurement information is available for

- the current 15 minute interval
- the most recent 96 - 15 minute intervals,
- the most recent 24 hour period (cumulative data)

## 9.3 235A ESF DATA LINK MONITORING, PROCESSING AND SENDING CAPABILITIES

In a nutshell, the 235A can support the full range of messaging defined by the ANSI T1.403 and by the AT&T publication 54016. Specifically, it can:

| | Capabilities | Section |
|---|---|---|
| 1. | monitor non-intrusively BOMs | 9.4.3 |
| 2. | monitor non-intrusively ANSI PRMs | 9.4.1 |
| 3. | compute ANSI PRMs impairment statistics | 9.4.2 |
| 4. | monitor non-intrusively AT&T REQs and RESPs | 9.4.4 |
| 5. | download (ANSI) PRMs impairment statistics | 9.5.1 |
| 6. | download all AT&T REQs and RESPs | 9.5.2 |
| 7. | send (intrusively) ANSI PRMs | 9.6.1 |
| 8. | send (intrusively) AT&T REQs | 9.6.2 |
| 9. | send (intrusively) BOMs | 9.6.3 |
| 10. | process the locally monitored impairments for transmission to the far end in: | |
| | - the ANSI format | 9.2.1 |
| | - the AT&T format | 9.2.2 |
| 11. | respond (intrusively) to AT&T REQs | 9.6.4 |

Consequently, the 235A can act as a message monitoring instrument and a command originator. It can also emulate terminal equipment compatible with both the ANSI and the AT&T ESF messaging standards. The following sections describe how to set-up the 235A to take full advantage of these capabilities.

## 9.4 MONITORING ESF DATA LINK MESSAGES

When the 235A (equipped with option 03B) monitors a DS1 circuit using the ESF format, any message carried by the data link can be displayed by the VFDT. To this end, depress momentarily the DATA LINK key in the CONTROLS and MEASUREMENTS section. When this is done, the VFDT displays screen [1] if no messages have been observed on the ESF data link.

Screen [1]

| |
|---|
| NO ESF DATALINK MSGS<br>HAVE BEEN RECEIVED |

The observation of data link messages causes the VFDT to instead display a screen similar to screen [2a] or screen [2b].

Screen [2a]

| ANSI-PRMs | AT&T-MSGs |
|---|---|
| BOMs | PRMs STATs |
| | # # |

Screen [2a] is displayed when all three types of messages have been observed and the ANSI-PRMs header is underlined. If one of the message types is missing, its header is blanked out. If either the BOMs header or the AT&T-MSGs header is underlined, screen [2a] is replaced by screen [2b].

Screen [2b]

| ANSI-PRMs | AT&T-MSGs |
|---|---|
| BOMs | CLR VIEW |
| | # # |

If the underline in screen [2b] is shifted to the ANSI-PRMs header using either pointer key) screen [2a] is displayed instead.

Depressing the CLR softkey when the BOMs header is underlined causes the BOM memory to be cleared of all stored messages and the BOMs header to be blanked out. Depressing the CLR softkey when the AT&T-MSGs header is underlined causes the AT&T-MSGs memory to be cleared of all stored messages and the AT&T-MSGs header to be blanked out. Depressing the VIEW softkey causes the VFDT to display the selected sequence of monitored messages.

To simplify the description in the text that follows, the screen exited upon depressing the PRMs, the STATs, or the VIEW softkeys, is referred to the 'root menu screen'.

**Notes**

1. Depressing the RESTART key causes all ESF related event memories to be cleared at once.

2. Depressing the DATA LINK key in the CONTROLS and MEASUREMENTS section while the root menu screen is displayed causes the VFTD to display the ESF data link receiver configuration screen. The configuration menu is described in section 9.4.5.

### 9.4.1 DISPLAYING PRMs IN REAL TIME

Depressing momentarily the PRMs softkey in screen [2a], causes the VFDT to display either a PRM related status message or the latest PRM received if it contains impairment data.

Screen [3a] is an example of a typical PRM related status message displayed when the most recently received PRM contained no impairment data. Screen [3b] is similar but it indicates that

[this space was intentionally left blank]

Screen [3a]

```
PRM ': No errors in
last second                NXT
                            #
```

Screen [3b]

```
PRM ': No errors in
last second          LPBK  NXT
                            #
```

the payload loopback condition prevails. In screens [3a] and [3b], the apostrophe next to PRM changes its orientation as each new PRM is received. This indicates that although the content of the PRM may not be changing, new PRMs are being received. When the most recently received PRM contains one or more impairments, a screen similar to screen [3c] is displayed.

Screen [3c]

```
PRM ':   SE    BPV      SLIP
CRC:101-319    LPBK     NXT
                            #
```

Screen [3d]

```
ANSI    PRMs have
stopped   06:48          NXT
                            #
```

Screen [3c] indicates that during the previous second the following conditions were identified:

- a Severely Errored Framing Event (SE)
- a BPV event (BPV)
- a SLIP event (SLIP)
- a CRC error count in the range 101-319 (CRC:101-319)
- the transmitting unit is in payload loopback (LPBK)

**Note:**

- Legitimate values for CRC counts are:
  0, 1, 2-5, 6-10, 11-100, 100-319, >319
- Frame synchronization bit error Event (FE) and SE are mutually exclusive
- An impairment header is displayed only if at least one such impairment event has occurred
- The LPBK header is displayed only if the target is in the payload looped back mode

If one or more seconds have elapsed since the last received PRM, the VFDT displays a screen similar to screen [3d]. Screen [3d] also identifies the time at which the last PRM was received. Depressing the NXT key in screens [3a] through [3d] cause the VFDT to display the root menu screen over again.

### 9.4.2. DISPLAYING PRM STATISTICS

Depressing the STATs softkey in screen [2a], causes the VFDT to display screen [4a], the first screen in the PRM statistics sequence.

Screen [4a]

```
# of received PRMs
  ######      PRV  NXT
                #    #
```

Screen [4a] displays the number of seconds with PRMs. Depressing the NXT softkey in this screen causes the display of screen [4b].

Screen [4b]

```
# of missing PRMs
  ######      PRV  NXT
                #    #
```

Screen [4b] displays the number of seconds without PRMs. Depressing the NXT softkey in this screen causes the display of a screen similar to screen [5].

Screen [5]

```
  EFS      %EFS
######    ###.##      NXT
                       #
```

Screen [5] gives the total count of error-free seconds and % error-free seconds. Depressing the NXT softkey in this screen causes the display of a screen similar to screen [6].

Screen [6]

```
  ES        SES
######    ######      NXT
                       #
```

Screen [6] indicates the total count of ES and SES. Depressing the NXT softkey in this screen causes the display of a screen similar to screen [7].

Screen [7]

```
   UAS
  ######      PRV  NXT
                #    #
```

Screen [7] displays the cumulative number of UAS seconds. Depressing the NXT softkey in this screen causes the display of a screen similar to screen [8a].

Screen [8a]

```
 0 CRC EVNT
  ######      PRV  NXT
                #    #
```

Screen [8a] gives the number of seconds in which no CRC error events occurred. Depressing the NXT softkey in this screen causes the display of a screen similar to screen [8b].

Screen [8b]

```
 1 CRC EVNT
  ######      PRV  NXT
                #    #
```

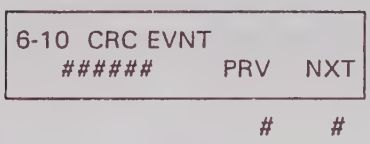
Screen [8b] gives the number of seconds in which a single CRC error event occurred. Depressing the NXT softkey in this screen causes the display of a screen similar to screen [8c].

Screen [8c]

```
2-5 CRC EVNT
  ######      PRV  NXT
                #    #
```

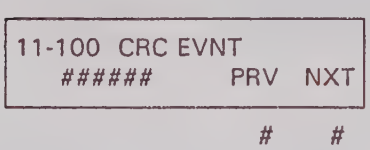
Screen [8c] gives the number of seconds in which two to five CRC error events occurred. Depressing the NXT softkey in this screen causes the display of a screen similar to screen [8d].

Screen [8d]



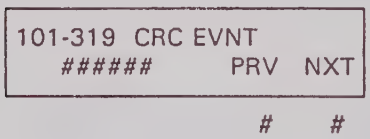

Screen [8d] gives the number of seconds in which six to ten CRC error events occurred. Depressing the NXT softktkey in this screen causes the display of a screen similar to screen [8e].

Screen [8e]



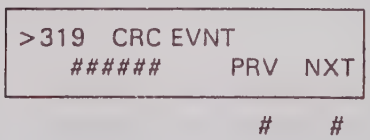

Screen [8e] gives the number of seconds in which 11 to 100 CRC error events occurred. Depressing the NXT softkey in this screen causes the display of a screen similar to screen [8f].

Screen [8f]



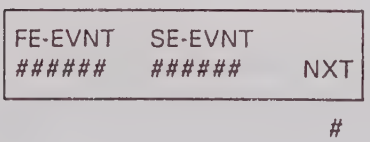

Screen [8f] gives the number of seconds in which 101 to 319 CRC error events occurred. Depressing the NXT softkey in this screen causes the display of a screen similar to screen [8g].

Screen [8g]



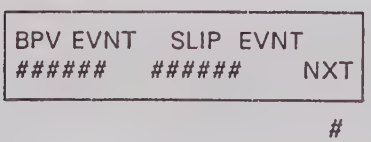

Screen [8g] gives the number of seconds in which over 319 CRC error events occurred. Depressing the NXT softkey in this screen causes the display of a screen similar to screen [9].

Screen [9]




Screen [9] gives the number of FE-EVENT seconds and SE-EVENT seconds. Depressing the NXT softkey in this screen causes the display of a screen similar to screen [10].

Screen [10]




Screen [10] gives the number of BPV EVENT seconds and SLIP-EVENT seconds. Depressing the NXT softkey in this screen causes the VFDT to display the root menu screen.

Depressing the RESTART key, at any time in the program, clears all the ANSI PRM statistics. Depressing the DATA LINK key in the CONTROLS and MEASUREMENTS section at any point in the PRM-STATs sequence causes the VFDT to display the root menu screen.

### 9.4.3. DISPLAYING BOMs

Depressing the VIEW softkey in the root menu screen when the BOMs header is underlined, causes the VFDT to display the first bit oriented message along with the time of its occurrence or its start and stop time. If a message is received continuously for over 800 ms, its 'BEGIN:' and 'END:' times are identified. This normally occurs for priority messages since they must be sent for at least one second. The list of identified priority messages as they are displayed by the VFDT is given in Table 9.1.

| | VFDT display | ANSI T1.403 Definition |
|---|---|---|
| 1. | YELLOW ALARM | : Yellow Alarm |
| 2. | PRIOR NTWK #1 | : Priority Network #1 |
| 3. | PRIOR NTWK #2 | : Priority Network #2 |
| 4. | PRIOR NTWK #3 | : Priority Network #3 |
| 5. | UD 0XXXXXX0 | : User-Defined |

**Table 9.1 Priority (BOM) Messages**

An example of a priority message received between 19:10:15 hours and 19:12:43 is given by screens [11a] and [11b].

Screen [11a]

```
BEGIN:   YELLOW ALARM
19:10.15          PRV  NXT
                   #    #
```

Depressing the NXT softkey in screen [11a] causes the VFDT to display a screen similar to screen [11b].

Screen [11b]

```
END:     YELLOW ALARM
19:12:43          PRV  NXT
                   #    #
```

Depressing the NXT softkey in screen [11b] causes the VFDT todisplay the next BOM message in the sequence. The last message in the sequence is identified by an underline.

Command messages are normally sent for a duration of 100 ms or so. They are identified by the 'CMD:' prefix. The list of identified command messages as they are displayed by the VFDT is given in Table 9.2. If, per chance, a command message is received for over 800 ms, it will be displayed by its 'BEGIN:' and 'END:' times instead of as a 'CMD:' message.

Screen [12] illustrates the LINE LOOP-UP command. This command was sent at 15:02:18 hours.

Screen [12]

```
CMD: LINE LOOP UP
15:02:18          PRV  NXT
                   #    #
```

Refer to Table 9.2 for the complete list of command/response messages that can be displayed by the VFDT.

| | VFDT display | ANSI T1.403 Definition |
|---|---|---|
| 1. | LINE LOOP-UP | : Line Loopback Activate |
| 2. | LINE LOOP-DN | : Line Loopback Deactivate |
| 3. | PAYLD LOOP-UP | : Payload Loopback Activate |
| 4. | PAYLD LOOP-DN | : Payload Loopback Deactivate |
| 5. | NTWK LOOP-UP | : Network Loopback Activate |
| 6. | NTWK LOOP-DN | : Network Loopback Deactivate |
| 7. | PROT SW L #1 | : Protection Switch Line 1 |
| 8. | PROT SW L #2 | : Protection Switch Line 2 |
| 9. | PROT SW L #3 | : Protection Switch Line 3 |
| 10. | PROT SW L #4 | : Protection Switch Line 4 |
| 11. | PROT SW L #5 | : Protection Switch Line 5 |
| 12. | PROT SW L #6 | : Protection Switch Line 6 |
| 13. | PROT SW L #7 | : Protection Switch Line 7 |
| 14. | PROT SW L #8 | : Protection Switch Line 8 |
| 15. | PROT SW L #9 | : Protection Switch Line 9 |
| 16. | PROT SW L #10 | : Protection Switch Line 10 |
| 17. | PROT SW L #11 | : Protection Switch Line 11 |
| 18. | PROT SW L #12 | : Protection Switch Line 12 |
| 19. | PROT SW L #13 | : Protection Switch Line 13 |
| 20. | PROT SW L #14 | : Protection Switch Line 14 |
| 21. | PROT SW L #15 | : Protection Switch Line 15 |
| 22. | PROT SW L #16 | : Protection Switch Line 16 |
| 23. | PROT SW L #17 | : Protection Switch Line 17 |
| 24. | PROT SW L #18 | : Protection Switch Line 18 |
| 25. | PROT SW L #19 | : Protection Switch Line 19 |
| 26. | PROT SW L #20 | : Protection Switch Line 20 |
| 27. | PROT SW L #21 | : Protection Switch Line 21 |
| 28. | PROT SW L #22 | : Protection Switch Line 22 |
| 29. | PROT SW L #23 | : Protection Switch Line 23 |
| 30. | PROT SW L #24 | : Protection Switch Line 24 |
| 31. | PROT SW L #25 | : Protection Switch Line 25 |
| 32. | PROT SW L #26 | : Protection Switch Line 26 |
| 33. | PROT SW L #27 | : Protection Switch Line 27 |
| 34. | PROT SW ACK | : Protection switch Acknowledge |
| 35. | PROT SW REL | : Protection switch Release |
| 36. | SYNCH MSG #1 | : Synchronization #1 |
| 37. | SYNCH MSG #2 | : Synchronization #2 |
| 38. | SYNCH MSG #3 | : Synchronization #3 |
| 39. | SYNCH MSG #4 | : Synchronization #4 |
| 40. | NTWK MSG #1 | : Network Message #1 |
| 41. | NTWK MSG #2 | : Network Message #2 |
| 42. | NTWK MSG #3 | : Network Message #3 |
| 43. | NTWK MSG #4 | : Network Message #4 |
| 44. | NTWK MSG #5 | : Network Message #5 |

Table 9.2 Command/Response (BOM) Messages

When an unidentified BOM message is captured, the 235A helps you trace it by displaying a screen similar to screens [13a], [13b] or [13c]. The 8 bits listed represent the unidentified code. This capability is extremely helpful for tracing obscure system malfunctions resulting from misassigned or corrupted codes.

Screen [13a]

```
BEGIN:  (?) 01110101
15:02:18          PRV  NXT
                  #    #
```

Screen [13b]

```
END:  (?) 01110101
15:02:18          PRV  NXT
                  #    #
```

Screen [13c]

```
CMD:  (?) 01110101
15:02:18          PRV  NXT
                  #    #
```

The PRE(vious) softkey in screens [11a] through [13c] help you navigate through the screen sequence.

Depressing the DATA LINK key in the CONTROLS AND MEASUREMENTS section at any point in the BOM sequence causes the VFDT to display the root menu screen.

### 9.4.4. DISPLAYING AT&T REQ/RESP MESSAGES

When the 235A DS1 RCVR input is patched to a line, it monitors all ESF data link messages. When the messaging complies with the AT&T format, one direction of transmission typically carries only the request messages. The other transmission direction carries the response messages. Because each response message contains a copy of the request, it is possible for the 235A to capture both the request and the response when the instrument monitors the response direction.

Depressing momentarily the VIEW softkey in screen [2c], [2d], or [2e] when the AT&T-MSGs selection is underlined, causes the VFDT to display either a REQ(uest) message or a RESP(onse) message along with the time of occurrence. Corrupted messages are also displayed upon occurrence. Refer to Sections 9.4.4.1, 9.4.4.2, and 9.4.4.3 for additional information about these messages.

#### 9.4.4.1 DISPLAYING AT&T REQUEST MESSAGES

Screen [14]

```
REQ: EN  1HR  PERF  MSG
15:58    PRNT PRV   NXT
                #    #    #
```

An example of a REQ message is given by screen [14]; this screen shows that a 1 hour performance message request was observed at 15:58 hours. All messages are stored in chronological order.

Table 9.3 below contains the list of all request messages recognized by the 235A as they are displayed by the VFDT, along with the corresponding formal definition given in the AT&T publication 54016.

| 235A Messages | AT&T Messages |
|---|---|
| REQ: PAYLOAD LOOP-UP | Activate Payload Loopback |
| REQ: PAYLOAD LOOP-DN | Deactivate Payload Loopback |
| REQ: ERR ESF MSG | Send Errored ESF Data |
| REQ: 1HR PERF MSG | Send 1 Hour Performance Data |

*Part of Table 9.3* *(continued)*

| 235A Messages | AT&T Messages |
|---|---|
| REQ: EN 1HR PERF MSG | Send Enhanced 1 Hour ES performance Data |
| REQ: 24HR UAS MSG | Send 24 Hour UAS Performance Data |
| REQ: EN 24HR UAS MSG | Send Enhanced 24 Hour UAS Performance Data |
| REQ: 24HR ES MSG | Send 24 Hour ES Performance Data |
| REQ: EN 24HR ES MSG | Send Enhanced 24 Hour ES Performance Data |
| REQ: EN 24HR BES MSG | Send Enhanced 24 Hour BES Performance Data |
| REQ: EN 24HR SES MSG | Send Enhanced 24 Hour SES Performance Data |
| REQ: EN 24HR CSS MSG | Send Enhanced 24 Hour CSS and LOFC Performance Data |
| REQ: EN CI CFG MSG | Send Enhanced CI Configuration Data |
| REQ: CLR PERF CNTRS | Reset Performance Monitoring Counters |
| REQ: CLR ESF CNTR | Reset Errored ESF Data |
| REQ: UNKNOWN MSG | [Not a request defined by AT&T] |

Table 9.3 Displayed Request Messages

### 9.4.4.2 DISPLAYING AT&T RESPONSE MESSAGES

Although the contents of performance response data messages and confirmation messages differ greatly, the 235A displays them in the same manner. These messages are all prefixed by 'RESP:'. Table 9.4 below gives a complete list of all AT&T response messages as they are displayed on the screen along with their definition as given in AT&T publication 54016.

| Displayed Messages | AT&T Message Definitions |
|---|---|
| RESP:ERR ESF MSG | Received Errored ESF Data |
| RESP:1HR PERF MSG | Received 1 Hour Performance Data |
| RESP:EN 1HR PERF MSG | Received Enhanced 1 Hour ES Performance Data |
| RESP:24HR UAS MSG | Received 24 Hour UAS Performance Data |
| RESP:EN 24HR UAS MSG | Received Enhanced 24 Hour UAS Performance Data |
| RESP:24HR ES MSG | Received 24 Hour ES Performance Data |
| RESP:EN 24HR ES MSG | Received Enhanced 24 Hour ES Performance Data |
| RESP:EN 24HR BES MSG | Received Enhanced 24 Hour BES Performance Data |
| RESP:EN 24HR SES MSG | Received Enhanced 24 Hour SES Performance Data |
| RESP:EN 24HR CSS MSG | Received Enhanced 24 Hour CSS and LOFC Performance Data |
| RESP:EN CI CFG MSG | Received Enhanced CI Configuration Data |
| RESP:PAYLOAD LOOP-UP | Confirm Activate Payload Loopback |
| RESP:PAYLOAD LOOP-DN | Confirm Deactivate Payload Loopback |
| RESP:CLR PERF CNTRS | Confirm Reset Performance Monitoring Counters |
| RESP:CLR ESF CNTR | Confirm Reset Errored ESF Data |
| RESP:UNKNOWN MSG | [Not a response defined by AT&T] |
| RESP:INVALID REQ | [The received request was not valid] |

Table 9.4 Displayed AT&T Response Messages

An example of a screen indicating the receipt (and capture) at 15:58 hours of an enhanced 24-hour ES (errored seconds) message is given by screen [15].

Screen [15]

```
RESP:EN  24HR  ES  MSG
15:58    PRNT  PRV  NXT
         #     #    #
```

A flashing underline at the top line in screen [15], flags the most recently received AT&T response message.

Screen [16]

```
RESP:PAYLOAD     LOOP-UP
15:58    PRNT  PRV  NXT
         #     #    #
```

An example of a screen indicating the receipt at 16:08 hours of a message confirming payload loopback is given by screen [16].

Depressing the PRNT key in screens [15] or [16] causes the time and date stamped message contents to be downloaded via the RS-232-C port to a printer or a terminal as described in Section 9.5.2.

To help in tracing the cause of system malfunctions resulting from the sending of unknown messages by any equipment communicating via the ESF data link, the 235A identifies unknown messages by displaying a screen similar to screen [18] below.

If a received message is not recognized, the VFDT displays a screen similar to screen [17] or [18] depending on whether the message is a request or a response. The time of occurrence is provided on the bottom line of the screen.

Screen [17]

```
REQ: UNKNOWN MSG
15:58    PRNT  PRV  NXT
         #     #    #
```

Screen [18]

```
RESP: UNKNOWN MSG
15:58    PRNT  PRV  NXT
         #     #    #
```

Depressing the PRNT key in screens [17] and [18] causes a time and date stamped message to be downloaded via the RS-232-C port to a printer or a terminal as described in Section 9.5.2.

### 9.4.4.3. CORRUPTED AT&T REQ/RESP MESSAGES

In the event that a message has been corrupted, its checksum is in error. You are alerted of this condition by a screen similar to screen [19a]; this screen also indicates the time of occurrence. If a message has a format different from either the ANSI or the AT&T message format, screen [19b] is displayed.

Screen [19a]

```
MSG: CHECKSUM  ERROR
15:58    PRNT  PRV  NXT
         #     #    #
```

Screen [19b]

```
MSG:NOT  AT&T  OR  ANSI
15:58    PRNT  PRV  NXT
         #     #    #
```

Depressing the PRNT softkey in screen [19a] causes the download to the printer of the message. The same action in screen [19b] causes the download of up to 260 hexadecimal characters (0-9, A, B, C, D, E, F) to help in the identification of the message.

Use the NXT and PRV(ious) softkeys in screens [13] through [19b] to navigate between screens. Depressing the DATA LINK key in the CONTROLS AND MEASUREMENTS section at any point in the AT&T message sequence causes the VFDT to display the root menu screen anew.

### 9.4.5 CONFIGURING THE RCVR

When the VFDT displays the root menu screen, depressing the DATA LINK key in the CONTROLS AND MEASUREMENTS section causes the VFDT to display the first configuration menu as shown by screen [20].

Screen [20]

```
RESP  TO  AT&T  REQs:
              YES  NO  NXT
               #    #   #
```

Screen [21]

```
VALID TARGET    ADDRESS
  ANY   A B Y Z     NXT
                     #
```

When the NO header is underlined, the 235A outgoing data link will not respond to any AT&T requests. Depressing the NXT softkey causes the VFDT to display the root menu screen anew. Depressing the YES softkey causes the underline to be transferred to this header. When the YES header is underlined in screen [20], depressing the NXT softkey causes the VFDT to display screen [21].

Either pointer softkey can be used for moving the pointer to the desired address. When the ANY header is underlined, all request messages seen by the ESF data link receiver will be responded to by the 235A on the T1 output via the ESF data link.

When either the A, B, Y , or Z header is underlined, only those request messages carrying respectively the A, B, Y, or Z target address will result in a response. All messages carrying a different address will be ignored by the ESF data link receiver.

> **Note**
> Normally CIs are set to address A or Z. CSUs, on the other hand, use address B or Y.

## 9.5 PRINTING ESF DATA LINK MESSAGES

A printer connected to the 235A RS-232-C port allows you to obtain a permanent record of the ESF data link messages/transactions. A printer is also required for analyzing the content of AT&T performance reports.

To successfully download ESF data link messages to a printer, the RS-232-C port must be configured as required by the printer. Refer to chapter 12 for port configuration instructions. Detailed instructions for printing ANSI messages and AT&T messages are given respectively in Sections 9.5.1 and 9.5.2.

### 9.5.1 PRINTING ANSI MESSAGES

The 235A gives you a choice of two types of ANSI message-based reports suitable for printing:

1. impairment activity reports
2. impairment summary reports

### 9.5.1.1 PRINTING IMPAIRMENT ACTIVITY REPORTS

Activity reports contain error events conveyed by PRMs. They are downloaded automatically in a semi event-driven mode. In this mode, an activity report is downloaded only if one or more impairments were reported during a selected time interval. This time interval can be set to any value in the range of 1 to 99 minutes. If, for instance, the selected time interval is one minute, the activity report is printed at most once per minute. Each activity report contains the total number of occurrences reported for each type of impairment, unless the impairment count is zero. In this case, no report is given for that impairment.

Activity reports delivered by the 235A are not specific to the PRM reported error events. When the

| DATE | TIME | EVENTS | COUNTS |
|---|---|---|---|
| 10/25/44 | 11:07 | BPV | 1 |
| | | CRC ERRS | 851 |
| | | FR BIT ERR | 5 |
| | | ERR-SEC | 12 |
| | | SES | 3 |
| | | FR LOSS-SEC | 2 |
| | | SYNC LOSS SECS | 2 |
| | | PRM ES | 12 |
| | | PRM SES | 1 |
| | | PRM 1 CRC-SEC | 3 |
| | | PRM 2-5 CRC-SEC | 2 |
| | | PRM 11-100 CRC | 1 |
| | | PRM 101-319 CRC | 2 |
| | | PRM >319 CRC-SEC | 1 |
| | | PRM FE-SEC | 2 |
| | | PRM BPV-SEC | 1 |

Figure 9.1 Sample Of An Activity Report

DS1 RECEIVER detects transmission impairments on the monitored T1 line, these impairments are also identified in the activity reports. PRM reported error events are listed with the PRM prefix. Figure 9.1 shows an example of an activity report containing PRM reported error events and T1 transmission impairments detected by the 235A receiver.

This semi event-driven mode can significantly reduce the length of a printed record while making the report easier to read. If the knowledge of the precise time of occurrence of an impairment is not crucial, the interval can be set to a high value, say 30 minutes or longer. Otherwise, it is generally set to one minute.

To set the printing interval, proceed as follows:

- depress the MODE key/menu in the CONTROLS AND MEASUREMENTS section
- with either pointer keys select the PRNT header
- depress the NXT softkey repeatedly until the VFDT displays screen [22].

Screen [22]

| | | | |
|---|---|---|---|
| Time Date | SW | S2 | PRNT |
| REPRT TMR | 01 | SET | NXT |
| | | # | # |

Depress the SET softkey in screen [20]
This causes the VFDT to display screen [23].

Screen [23]

| ACTIVITY | REPORT | 01 |
|---|---|---|
| TIMER | UP DN | SET |
| | # # | # |

Depress the UP or DN softkeys in screen [23] as required to obtain the desired interval.

- Finally, depress the SET softkey in screen [23]. This causes the VFDT to display screen [22] again, but with the new value for the interval duration.

### 9.5.1.2. PRINTING IMPAIRMENT SUMMARY REPORTS

The 235A allows you to obtain a printed record of a summary of all impairment activity reported via PRMs since the instrument was RESTARTed.

To download the summary data proceed as follows:
- with either pointer keys select the PRNT header in the MODE menu

Screen [24]

| Time Date | SW | S2 | PRNT |
|---|---|---|---|
| PRM SUMMARY | | GO | NXT |
| | | # | # |

Depress the GO softkey in screen [24]. This causes the downloading of the PRM summary report to the printer.

- depress the NXT softkey repeatedly until the VFDT displays screen [24].

An example of an ANSI PRM summary report is given in Figure 9.2.

```
                ANSI PRM SUMMARY
DATE: 10/25/44                  TIME 11:06
TEST TIME :   0:06:28
  PRM DATA SECONDS                   371
  SECS w/o PRM MSG                     0
  EFS                                359
  % EFS                            96.77
  ES                                  12
  SES                                  1
  UAS                                  0
  0 CRC ERR-SECS                     362
  1 CRC ERR-SECS                       3
  2-5 CRC ERR-SECS                     2
  6-10 CRC ERR-SECS                    0
  11-100 CRC ERR-SECS                  1
  101-319 CRC ERR-SECS                 2
  > 319 CRC ERR-SECS                   1
  FE EVENT-SECS                        2
  SE EVENT-SECS                        0
  BPV EVENT-SECS                       1
  SLIP EVENT-SECS                      0

END ANSI PRM SUMMARY
```

Figure 9.2 Example Of An ANSI PRM Summary Report

In the above PRM summary report, the TIME header refers to the actual time of day. The TEST TIME header refers to the time elapsed since the beginning of the test.

This manually selected report provides a useful snapshot of the impairment activity observed during a test period.

### 9.5.2 PRINTING AT&T FORMATTED MESSAGES

When a printer is connected to the RS-232-C port, all AT&T formatted messages received by the 235A on the monitored ESF data link are automatically downloaded upon receipt. They can also be downloaded on-demand at a later time.

To print on-demand, simply depress the PRNT key in any screen displaying AT&T messages while a printer is connected to the RS-232-C port. The printer must, of course, be under power and set to the ON-LINE mode.

Some examples of printouts are given in Figure 9.3 through 9.6 below along with some descriptive information.

```
18:53:12  2/28/92   DATALINK RECEIVED:
   REQ: 1 HR PERF MSG
   ORG UNIT ADDR 001, TARGET ADDR  A
18:53:12  2/28/92   DATALINK RECEIVED:
   RESP: 1 HR PERF MSG
   ORG UNIT ADDR 001, TARGET ADDR  A
   VALID INTERVALS - 96
   SECONDS IN CURRENT INTERVAL - 419
   INTERVAL     ES    UAS
   CURRENT       0      0
   24 HRS        0      0
     1           0      0
     2           0      0
     3           0      0
     4           0      0
```

**Figure 9.3 AT&T 1-Hour Performance Request and Report**

Figure 9.3 shows a record of the REQuest for a 1-hour performance report followed by the actual RESPonse.

The REQ identifies:
- the time and date of message capture
- the nature of the REQ (1 HR PERF MSG)
- the originating unit address (001)
- the target unit address (A)

The RESP identifies:
- the time and date of the message capture
- the type of message received (1 HOUR PERF MSG)
- the address of the message originating unit (001)

- the address of the target unit (A)
- the number of consecutive 15-minute intervals for which data has been captured by the message sending unit (96)
- the number of seconds in the current interval with fewer than 900 seconds (or 15 minutes) (419)
- the number of ES and UAS in the previous 24-hour period
- the number of ES and UAS in the four most recent 15-minute periods (1 is the most recent, 4 is the least recent).

```
18:54:39  2/28/92   DATALINK RECEIVED:
   RESP: EN 1HR PERF MSG
   ORG UNIT ADDR 001, TARGET ADDR  A
   VALID INTERVALS - 96
   SECONDS IN CURRENT INTERVAL - 506
PERIOD  ES    UAS    BES    SES    CSS   LOFC
CURR     0      0      0      0      0      0
24HR     0      0      0      0      0      0
   1     0      0      0      0      0      0
   2     0      0      0      0      0      0
   3     0      0      0      0      0      0
   4     0      0      0      0      0      0
```

Figure 9.4 AT&T Enhanced 1-Hour Performance Report

The enhanced 1-hour performance report in Figure 9.4 differs from the 1-hour performance report in Figure 9.3 in supplying six additional performance indexes.

(This space left intentionally blank.)

```
18:55:16  2/28/92   DATALINK RECEIVED:
   RESP: EN 24HR ES MSG
   ORG UNIT ADDR 001, TARGET ADDR  A
   VALID INTERVALS - 96
   SECONDS IN CURRENT INTERVAL - 543
PERIOD  ES   UAS   BES   SES   CSS  LOFC
CURR     0     0     0     0     0     0
24HR     0     0     0     0     0     0
   ES FOR LAST 96 15 MINUTE INTERVALS
    1:  0   25:  0   49:  0   73:  0
    2:  0   26:  0   50:  0   74:  0
    3:  0   27:  0   51:  0   75:  0
    4:  0   28:  0   52:  0   76:  0
    5:  0   29:  0   53:  0   77:  0
    6:  0   30:  0   54:  0   78:  0
    7:  0   31:  0   55:  0   79:  0
    8:  0   32:  0   56:  0   80:  0
    9:  0   33:  0   57:  0   81:  0
   10:  0   34:  0   58:  0   82:  0
   11:  0   35:  0   59:  0   83:  0
   12:  0   36:  0   60:  0   84:  0
   13:  0   37:  0   61:  0   85:  0
   14:  0   38:  0   62:  0   86:  0
   15:  0   39:  0   63:  0   87:  0
   16:  0   40:  0   64:  0   88:  0
   17:  0   41:  0   65:  0   89:  0
   18:  0   42:  0   66:  0   90:  0
   19:  0   43:  0   67:  0   91:  0
   20:  0   44:  0   68:  0   92:  0
   21:  0   45:  0   69:  0   93:  0
   22:  0   46:  0   70:  0   94:  0
   23:  0   47:  0   71:  0   95:  0
   24:  0   48:  0   72:  0   96:  0
```

Figure 9.5 AT&T Enhanced 24-hour ES Performance Report

The 24-hour performance report in Figure 9.5 supplies the following information:

- the time and date of the message capture
- the name of the message report (EN 24HR ES MSG)
- the address of the originating unit (001)
- the address of the target unit (A)
- the number of valid consecutive 15-minute intervals for which data has been captured by the message sending unit (96)
- the number of seconds in the current interval with fewer than 900 seconds (15 minutes) (543)
- the number of ES, UAS, BES, SES, CSS, and LOFC in the current interval
- the number of ES, UAS, BES, SES, CSS, and LOFC in the previous 24-hour period
- the number of ES in the 96 most recent 15-minute periods (1 is the most recent, 96 is the least recent).

**Note**

If the number of valid intervals is less than 96, the 24-hour report reflects only that number times 15 minutes.

```
18:58:22  2/28/92   DATALINK RECEIVED:
   RESP: EN 24HR CSS MSG
   ORG UNIT ADDR 001. TARGET ADDR  A
   VALID INTERVALS - 96
   SECONDS IN CURRENT INTERVAL - 728
PERIOD  ES    UAS    BES    SES    CSS   LOFC
CURR     2      0      2      0      0      0
24HR     0      0      0      0      0      0
   COFC FOR LAST 96 15 MINUTE INTERVALS
      CSS LOFC      CSS LOFC      CSS LOFC
 1:   0    0   33:   0    0   65:   0    0
 2:   0    0   34:   0    0   66:   0    0
 3:   0    0   35:   0    0   67:   0    0
 4:   0    0   36:   0    0   68:   0    0
 5:   0    0   37:   0    0   69:   0    0
 6:   0    0   38:   0    0   70:   0    0
 7:   0    0   39:   0    0   71:   0    0
 8:   0    0   40:   0    0   72:   0    0
 9:   0    0   41:   0    0   73:   0    0
10:   0    0   42:   0    0   74:   0    0
11:   0    0   43:   0    0   75:   0    0
12:   0    0   44:   0    0   76:   0    0
13:   0    0   45:   0    0   77:   0    0
14:   0    0   46:   0    0   78:   0    0
15:   0    0   47:   0    0   79:   0    0
16:   0    0   48:   0    0   80:   0    0
17:   0    0   49:   0    0   81:   0    0
18:   0    0   50:   0    0   82:   0    0
19:   0    0   51:   0    0   83:   0    0
20:   0    0   52:   0    0   84:   0    0
21:   0    0   53:   0    0   85:   0    0
22:   0    0   54:   0    0   86:   0    0
23:   0    0   55:   0    0   87:   0    0
24:   0    0   56:   0    0   88:   0    0
25:   0    0   57:   0    0   89:   0    0
26:   0    0   58:   0    0   90:   0    0
27:   0    0   59:   0    0   91:   0    0
28:   0    0   60:   0    0   92:   0    0
29:   0    0   61:   0    0   93:   0    0
30:   0    0   62:   0    0   94:   0    0
31:   0    0   63:   0    0   95:   0    0
32:   0    0   64:   0    0   96:   0    0
```

Figure 9.6 AT&T Enhanced 24-hour CSS Performance Report

The enhanced 24-hour CSS performance record shown in Figure 9.6 has the same format as the previous record; it differs mainly in that both CSS and LOFC event counts are given instead of ES counts.

## 9.6 SENDING ESF DATA LINK MESSAGES

ESF data link messages can be sent by the 235A when the following conditions are met:

- the 235A is equipped with option 03B
- the selected DS1 pattern is framed
- the framing selection is ESF

When this is the case, the 235A transmitter can send all the ESF data link messages defined by ANSI T1.403 and by AT&T publication 54016. Specifically, the ESF data link transmit capabilities offered by the 235A include:

- broadcasting ANSI PRMs
- sending BOMs
- sending AT&T REQ messages
- responding to received AT&T REQ messages

All these capabilities are accessed by depressing the DATA LINK key in the DS1 TRANSMIT section when all the above listed conditions are met. Depressing this key causes the VFDT to display a screen similar to screen [25].

Screen [25]

| ANSI-PRMs | | AT&T-MSGs |
|---|---|---|
| BOMs | CNFG | NXT |
| | # | # |

ANSI-PRMs header is underlined by default

With the pointer keys either of the three message headers can be selected by shifting the underline. The CNFG softkey header is blanked-out when the BOMs header is underlined since no configuration settings are required for sending this type of message.

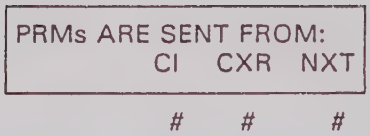
The ANSI-PRMs header and/or the BOMs header in screen [25] may be flashing on and off. The ANSI-PRM header flashes when PRMs are being sent once per second; the BOMs header flashes when priority messages are being sent.

A detailed description of the available selections for each message type in screen [25] is given in Sections 9.6.1, 9.6.2, and 9.6.3. The 235A response capability to received AT&T request messages is described in Section 9.6.4.

### 9.6.1. SENDING ANSI PERFORMANCE MESSAGES (PRMs)

As noted earlier, PRMs are broadcast once per second. They contain impairment reports prepared by the DS1 receiver. These reports reflect the transmission impairments detected by the DS1 receiver on the monitored line. When you want to send PRMs, you need to first set the configuration to identify the 235A either as a customer installation (CI) or as a carrier (CXR). To make this selection, move the underline to the ANSI-PRMs header in screen [25] and depress the CNFG softkey. This causes the VFDT to display a screen similar to screen [26].

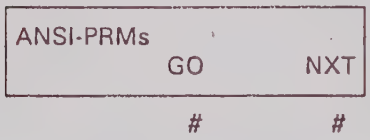
Screen [26]




In screen [26], either the CI or the CXR softkey header is underlined, indicating the current selection If CI is underlined, depressing the CXR softkey causes the underline to shift to this key. Depressing the NXT softkey causes the VFDT to display screen [25].

Depressing the NXT softkey in screen [25] when the ANSI-PRM header is underlined causes the VFDT to display screen [27a] or screen [27b]. screen [27a] is displayed if no PRM are being sent;

Screen [27a]




Screen [27b]

Screen [27b] is displayed if PRMs are being sent. Depressing the GO softkey causes PRMs messages to be broadcasted, and the VFDT to display screen [27b]. Depressing the STOP softkey in screen [27b] causes the VFDT to display screen [27a] anew. Depressing the NXT softkey in screen [27a] causes the VFDT to display screen [25]; in that screen, the ANSI-PRMs header is steadily lit.

Depressing the NXT softkey in screen [27b] causes the VFDT to display screen [25]; in that screen, the ANSI-PRMs header is flashing on and off.

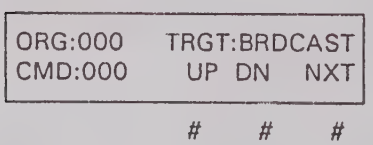
### 9.6.2. SENDING AT&T REQUEST MESSAGES (REQs)

Prior to sending AT&T request messages, several message parameters, globally referred to as 'configuration' must be defined. These parameters include:

- the command (CMD) identification, a number in the range 000 to 255.
- the origin (ORG) address, a number in the range of 000 to 255. (This is the actual address given to the 235A.)
- the target (TRGT) address. This is the address of the unit at the far end to which the REQs are destined. This address can be set to a specific 8 bit code represented by the ASCII numbers for the characters A, B, Y, or Z. Alternatively, a broadcast (BRDCAST) mode defines a special address allowing the commands to be accepted by all targets connected to the ESF data link.

To select these parameters, let the AT&T-MSGs header in screen[25] be underlined and depress the CNFG softkey. This causes the VFDT to display a screen similar to screen [28].

Screen [28]




To select the parameter to be updated, use the pointer keys to shift the underline accordingly. Use the UP and DN softkeys as required to obtain the required value or address.

Depressing the NXT softkey in screen [28] causes the VFDT to display screen [25]. Depressing the NXT header in that screen causes the VFDT to display the first REQuest in the request repertoire listed in Table 9.3. This request is shown in screen [29a].

Screen [29a]

```
REQ: PAYLOAD     LOOP-UP
              GO  PRV  NXT
              #   #    #
```

Depressing the GO softkey in this screem causes the payload loop-up request to be sent and the VFDT to display screen [29b].

Screen [29b]

```
SENT:PAYLOAD     LOOP-UP
<AWAITING RESP>     NXT
                    #
```

When a response has been received (by the DS1 RECEIVER) the screen is changed to read as shown by screen [29c].

Screen [29c]

```
SENT:PAYLOAD     LOOP-UP
<RESP RECEIVED>     NXT
                    #
```

Depressing the NXT softkey in screens [29b] or [29c] causes the VFDT to display screen [29a] again.

Depressing the NXT softkey in screen [29a] causes the VFDT to display the next REQ: in Table 9.3. All but the last command in this table can be displayed and sent by the 235A. To return to the root menu, screen [25], depress the DATA LINK key in the DS1 TRANSMIT section.

### 9.6.3. SENDING BOMs

Sending priority messages differs only slightly from sending command/response messages. Whereas priority messages can be sent for any duration, command/response messages are always sent for a short duration (typically, a 40 milliseconds burst). These two types of message are blended as BOMs but are differentiated by their prefix (PRIOR: or CMD:).

To access the BOM selection, shift the underline to the BOMs header in screen [25] and depress the NXT softkey. This causes the VFDT to display either a PRIORity message or a CMD message, depending on prior selections. A priority message is displayed by a screen similar to either screen [30a] or to [30b]. A command message is displayed by a screen similar to screen [30c].

Screen [30a]

```
PRIOR:   YELLOW  ALARM
              GO  PRV  NXT
              #   #    #
```

Screen [30b]

```
PRIOR:   YELLOW  ALARM
<SENDING>     STOP
                    #
```

When a priority message is displayed by the VFDT as in screen [30a], depressing the GO softkey causes the message to be sent and the VFDT to display the corresponding <SENDING> screen as shown by screen [30b] for the yellow alarm. Depressing the STOP softkey in screen [30b] causes the VFDT to display screen [30a] anew. Depressing the NXT softkey in screen [30a] causes the VFDT to display the next selection in Table 9.1 or in Table 9.2. (These two tables are to be considered as a single one here.)

Screen [30c]

```
CMD:  SYNCH  MSG  #1
            GO  PRV  NXT
              #    #    #
```

Screen [30d]

```
CMD:  SYNCH  MSG  #1
   HAS BEEN SENT
```

When a command message is displayed by the VFDT as in screen [30c], depressing the GO softkey causes the message to be sent and the VFDT to display the corresponding 'HAS BEEN SENT' screen as shown by screen [30d] for the SYNCH MSG #1. This screen is displayed only for two seconds and, at the end of this period, the previous screen is displayed again. Depressing the NXT softkey in screen [30c] causes the VFDT to display the next selection in Table 9.1 or in Table 9.2.

A special case of priority message is the user-defined message. As its name indicates, this message can be set by the user to any arbitrary 8-bit byte starting and ending with a 0. To change a user-defined code, proceed as follows:

- depress the NXT or the PRV softkeys until the USER-DEF screen is displayed; this screen is similar to screen [31a].

Screen [31a]

```
PRIOR:   UD  01110000
            GO  PRV  NXT
              #    #    #
```

Screen [31b]

```
PRIOR:   UD  01110000
<SENDING>      STOP
                   #
```

- using the pointer keys and the 1 and 0 keys, set bit 2 to 6 to the desired value. (This code is kept in the battery backed-up memory; as a result, you do not have to enter it again after the 235A power is turned off.)

Sending the user-defined code is done by depressing the GO softkey in screen [31a]. Depressing this key also causes the VFDT to display screen [31b].

To return to the root menu, screen [25], depress the DATA LINK key in the DS1 TRANSMIT section.

### 9.6.4 RESPONDING TO AT&T REQUEST MESSAGES

When the 235A is placed at the end of a line, in the place of customer terminating equipment for instance, it can supply AT&T formatted response messages onto the outgoing data link. These response messages are obtained by processing the impairments observed on the receive side of the line by the 235A DS1 RECEIVER. Detailed information about impairment processing and formatting

required to produce legitimate RESPs is provided by AT&T publication 54016 and, for brevity's sake, is not repeated here.

To deliver AT&T formatted response messages, three conditions must be met:
- the receiver must be configured to respond
- legitimate AT&T REQ messages must be received by the 235A, and
- the signal delivered by the TRANSMIT section on the T1 output must be internally generated

To configure the receiver to respond to legitimate REQs, refer to Section 9.4.5.

**Note**

Because DS1 signals supplied externally to the AUX DS1 input port are fed transparently through the test set to its T1 output, the test set cannot send RESP messages while a DS1 signal is applied to the AUX DS1 input jack.

# CHAPTER 10
# SENDING & RECEIVING SLC-96™ DATA LINK MESSAGES

## 10.1 INTRODUCTION

The information contained in this chapter pertains specifically to the capabilities afforded by option 03C. The capabilities described in this chapter will not apply to your 235A test set, if the option has not been installed.

When equipped with option 03C, the 235A can monitor and analyze the messages carried on the SLC-96 data link in real time. It is also capable of sending a number of user selectable messages on the data link. This document describes the operation of the SLC-96 data link capability.

## 10.2 SLC-96 DATA LINK BACKGROUND INFORMATION

In the SLC-96 system, a data link carries messages in full duplex between the central office and the remote terminal. This data link transports maintenance, alarm, and protection switch information for the system. Depending on the system configuration, either one or two data links are used. When configured in either modes I or III, only one data link is used. This data link is carried by the T1 line associated with shelf A. When configured in mode II, the concentrator mode, the data link associated with shelf A carries the same messages plus the concentrator data pertaining to both shelves A and B. A second data link associated with shelf B carries only the concentrator messages pertaining to shelves C and D.

This data link messaging scheme is compatible with all SLC-96 system configurations. This includes: Central Office Terminal (COT), Subscriber Loop Interface Module (SLIM), or Local integrated Digital Switch (LDS) working with a Remote Terminal (RT).

Maintenance (MTCE) messages are sent over the data link in response to commands from the pair gain test controller or loop testing system. The maintenance field is used by the pair gain test controller or similar test system to control channel and drop testing.

Alarm messages are sent by the RT to the COT to identify a number of abnormal conditions.

Protection switch messages are provided to obtain an orderly transfer of the traffic to a back-up (protection) line. The remote looping capability is also used to facilitate maintenance and trouble shooting of the transmission network.

In the concentrator mode, data link messages carry the status of each subscriber line number from the RT to the COT. The concentrator messages specify the time slot assignment of each subscriber line in the opposite direction.

(This space left intentionally blank.)

---

SLC-96 is a trademark of AT&T Technology, Inc.

## 10.3 235A SLC-96 DATA LINK MONITORING, PROCESSING AND SENDING CAPABILITIES

In a nutshell, the 235A can support the full range of messaging defined by the Bellcore TR-TSY-000008. Specifically, it can:

| Capabilities | Section |
|---|---|
| 1. monitor non-intrusively all messages | 10.4 |
| 2. print all monitored messages | 10.5 |
| 3. send alarm and protection line switch messages | 10.6 |

Consequently, the 235A can act as a SLC-96 data link message monitoring instrument and a command originator. It can be used at either end of the system with equal ease. The following sections describe how to set-up the 235A to take full advantage of these capabilities.

## 10.4 MONITORING SLC-96 DATA LINK MESSAGES

When the 235A (equipped with option 03C) monitors a DS1 circuit using the SLC-96 format, any message carried by the data link can be displayed by the VFDT.

> Remark:
> Although the 235A DS1 Transmit and Receive can operate independently, the data link capability is common to both sections. Thus to use the SLC-96 data link monitoring capability, the DS1 Transmit cannot be used to send an ESF formatted data link. It can however send SLC-96 data link messages or operate with SF framing.

To this end, depress momentarily the DATA LINK key in the CONTROLS and MEASUREMENTS section. The first screen displayed by the VFDT if the DS1 Receive Diagnostics section is framed on a SLC-96 bit stream is a configuration screen similar to screen [1].

Screen [1]

```
MONITOR SLC DATALINK
FROM RT  TO RT      NXT
                     #
```

The underline can be shifted by using the pointer keys. Select FROM RT to monitor messages sent by the RT. Select TO RT to monitor messages sent by the COT, a SLIM, or a Digital Interface. Upon depressing the NXT key, a summary screen similar to screen [2] is displayed.

> **Note**
> Proper selection of the messaging direction is required for correct display of both concentrator and maintenance messages.

Screen [2]

```
PLS:IDLE  MTCE:IDLE
ALM:NONE CFLD:A     NXT
                     #
```

At a glance, this screen identifies the content of the four message fields:
- the protection line switch field (PLS)
- the maintenance field (MTCE)
- the alarm field (ALM), and
- the concentrator field (CFLD).

The possible content of each message field is given below:

- The protection line switch commands sent in response to requests from individual shelves are listed in table 10.1.
- Maintenance messages sent by the RT are listed in table 10.2. The maintenance messages sent to the RT are listed in table 10.3.
- The alarm messages include: YES, NONE, or UFR (unframed).
- The concentrator messages are: A (active), I (idle), U (unrecognized).

| PLS bits | | | | Display | Message description |
|---|---|---|---|---|---|
| S1 | S2 | S3 | S4 | | |
| 1 | 1 | 1 | 1 | IDLE | idle condition |
| 1 | 1 | 1 | 0 | A-R | Switched line A RCV |
| 1 | 1 | 0 | 1 | B-X | Switched Line B XMT |
| 1 | 1 | 0 | 0 | C-X | Switched Line C XMT |
| 1 | 0 | 1 | 0 | D-X | Switched Line D XMT |
| 0 | 1 | 0 | 1 | B-XR | Switched Line B XMT and RCV |
| 0 | 1 | 0 | 0 | C-XR | Switched Line C XMT and RCV |
| 0 | 0 | 1 | 0 | D-XR | Switched Line D XMT and RCV |
| other | | | | UNKN | illegal (unknown) |

**Table 10-1 Protection line switch messages**

| MTCE bits | | | Display | Message description |
|---|---|---|---|---|
| M1 | M2 | M3 | | |
| 0 | 0 | 0 | TSTALM | Display Test Alarm |
| 0 | 0 | 1 | S/PRC | Seize RC/Proceed RC |
| 0 | 1 | 0 | TSTALM | Display Test Alarm |
| 0 | 1 | 1 | SRC | Seize RC |
| 1 | 0 | 0 | TSTALM | Display Test Alarm |
| 1 | 0 | 1 | PRC | Proceed RC |
| 1 | 1 | 0 | TSTALM | Test Alarm RC |
| 1 | 1 | 1 | IDLE | IDLE |

**Table 10.2 Maintenance messages sent by the RT**

| MTCE bits | | | Display | Message description |
|---|---|---|---|---|
| M1 | M2 | M3 | | |
| 0 | 0 | 0 | TSTALM | Display Test Alarm |
| 0 | 0 | 1 | ON/PRC | On Hook/Proceed RC |
| 0 | 1 | 0 | TSTALM | Display Test Alarm |
| 0 | 1 | 1 | ON-H | On Hook |
| 1 | 0 | 0 | TSTALM | Display Test Alarm |
| 1 | 0 | 1 | PCR | Proceed CR |
| 1 | 1 | 0 | TSTALM | Test Alarm CR |
| 1 | 1 | 1 | IDLE | IDLE |

**Table 10.3 Maintenance messages sent to the RT**

While the protection line switch (PLS) commands and the maintenance (MTCE) messages are listed directly in screen [2], the alarm (ALM) and the concentrator (CFLD) messages, if any, are accessed by depressing the NXT key while the ALM or the CFLD header is underlined. Examples of alarm message and concentrator message displays are given below.

Screen [3]

```
PLS:IDLE  MTCE:IDLE
ALM:YES  CFLD:A        NXT
                         #
```

Depressing the NXT key yields a screen similar to screen [4a] if the alarm is sent by a COT-RT-13 or similar to screen [4b] if the alarm is sent by a COT-RT-16 or a SLIM.

Screen [4a]

```
<MAJOR ALARM>     :ALM
234567890123       NXT
                     #
```

Screen [4b]

```
<A SHELF ALARM>   :ALM
2345678 90123456   NXT
                     #
```

In screens [4a] and [4b], any combination of digits may be flashing on and off to indicate which alarm is active. The top line indicates the name of the underlined digit. In screen [4a], the underlined 2 yields ' MAJOR ALARM'; in screen [4b], the underlined 8 yields 'A SHELF ALARM'. Table 10.4 lists all the messages supplied by the three system variations.

| ALM Message | COT-RT-13 Alarm No. | COT-RT-16 Alarm No. | SLIM Alarm No. |
|---|---|---|---|
| Major Alarm | 2 | 5 | 5 |
| Minor Alarm | 3 | 6 | - |
| PWR/MISC | 4 | 7 | - |
| A Shelf ALM | 5 | 8 | 8 |
| B Shelf ALM | 6 | 9 | 9 |
| C Shelf ALM | 7 | 10 | 10 |
| D Shelf ALM | 8 | 11 | 11 |
| A Line FELP | 9 | 12 | - |
| B Line FELP | 10 | 13 | - |
| C Line FELP | 11 | 14 | - |
| D Line FELP | 12 | 15 | - |
| P Line FELP | 13 | 16 | - |

Table 10.4 Alarms messages for COT-RT-13, COT-RT-16, and SLIM

Depressing the NXT key in screens [4a] and [4b] causes the display of the root screen (either screen [2] or [3]).

If the CFLD:A is underlined in the root menu, depressing the NXT softkey yields a message summary/status and the time slot assignment associated with either the RT or the COT depending on the selection in screen [1].

If the selection in screen [1] is FROM RT, depressing the NXT softkey in the root menu causes the display of a screen similar to screen [5].

Screen [5]

```
IDLE ACT ACT-UPD AUR
NALM LT ERR      CLR  NXT
                  #    #
```

This screen displays the messages sent by the RT since the last time the screen (and the message memory) was cleared. The screen and the memory are cleared by depressing the CLR softkey. Normally, all the message fields are blank. A message is displayed only when an event is recognized. An error is displayed when two of the three messages generating a specific line assignment are not identical; it is also declared when the 'CFLD:' is U in screen [2]. IDLE is

displayed when the content of the CFLD consists of idle messages for a period of over 200ms. Table 10.5 lists all the recognized messages sent by the RT operating in the concentrator mode (II) along with the abbreviations used for display on the screen.

| RT-generated messages | Display |
|---|---|
| IDLE | IDLE |
| Activity | ACT |
| Activity Update | ACT-UPD |
| Activity Update Request | AUR |
| No Alarm | NALM |
| Loop Test | LT |
| Error in message concentrator field | ERR |

**Table 10-5 Concentrator status messages**

Depressing the NXT softkey in screen [5] causes the VFDT to display a screen similar to screen [6].

Screen [6]

```
  1 2 3 4 5 6 7 8 9   <SUB LNE
  ↑ ↓ ↓ ↓ ↑ - ↓ ↓ ↓   PRV NXT
                      #   #
```

Screen [6] displays the status of the subscriber line numbers 1 through 9. ↑ indicates off-hook. ↓indicates on-hook. A missing status is shown by a dash, as shown for line 6. Depressing the NXT softkey in screen [6] causes the screen to display screen [7].

Screen [7]

```
10  1 2 3 4 5 6 7 8 9 <SUB LNE
 ↑  ↑ ↓ ↓ ↓ ↑ ↑ ↓ ↓ ↓ PRV NXT
                      #   #
```

Screen [7] displays the status of the subscriber line numbers 10 through 19. Depressing the NXT softkey causes the screen to display the state of the next 10 lines. The last screen in the sequence is displayed below as screen [8].

Screen [8]

```
40  1 2 3 4 5 6 7 8   <SUB LNE
 ↑  ↑ ↓ ↓ ↓ ↑ ↑ ↓ ↓   PRV NXT
                      #   #
```

Screen [8] displays the status of the subscriber line numbers 40 through 48. Depressing the PRV softkey enables you to review a previous screen. Depressing the NXT key causes the VFDT to display a screen similar to screen [9].

Screen [9]

```
  1 2 3 4 5 6         : GROUP
  A U - U A A         PRV NXT
                      #   #
```

This screen shows an example of the status of the messages for each of the six groups (of eight lines) from which the subscriber line data is obtained. The symbols represent:

A : Activity Report
U : Activity update report
- : Report not received.

Pressing the NXT softkey in screen [9] causes the VFDT to display screen [5].

If the selection in screen [1] is TO RT, depressing the NXT softkey in the root menu when the CFLD:Y header is underlined causes the display of a screen similar to screen [10].

Screen [10]

```
IDLE TR-AS/DS LT        AUR
ASG-UPD ERR      CLR    NXT
                 #      #
```

This screen displays the messages received by the RT since the last time the screen (and the message memory) was cleared. The screen and the memory are cleared by depressing the CLR softkey. A message is displayed only when an event is recognized. An error is displayed when two of the three messages generating a specific time slot assignment are not identical. Table 10.6 lists all the recognized messages sent to the RT operating in the concentrator mode (II) along with the abbreviations used for display on the screen.

| RT-received messages | Display |
|---|---|
| Idle | IDLE |
| Trunk Assignment/Deassignment | TR-AS/DS |
| Loop Test | LT |
| Assignment Update Request | AUR |
| Assignment Update | ASG-UPD |
| Error in message concentrator field | ERR |

**Table 10-6 Concentrator status messages**

Depressing the NXT softkey in screen [10] causes the VFDT to display a screen similar to screen [11].

Screen [11]

```
 1    2    3    4    < TS
15    I    -   34    NXT
                     #
```

Screen [11] displays the status of the trunk/time slot assignments for time slot 1 through 4. The digits represent the assigned subscriber line number; I indicates that the channel is idle; - indicates that the assignment has not been received. Depressing the NXT softkey in screen [11] yields the time slot assignment for the next four time slots. A total of six screens can be displayed to supply the assignment of each of the 24 time slots supported by the T1 line.

Information in the time slot assignment screens is displayed in real time. Depressing the NXT softkey while the screen displays the assignment for time slots 21 through 24 causes the VFDT to display screen [10] again.

## 10.5 PRINTING SLC-96 DATA LINK MESSAGES

With a printer connected to the 235A RS-232-C port, a record can be made of most of the SLC-96 data link activities. To successfully download SLC-96 data link messages to a printer, the RS-232-C port must be configured to support the printer. Refer to chapter 12 in this manual for configuration information.

This section describes the messages that can be downloaded to the RS-232-C port while monitoring a SLC-96 data link.

### 10.5.1 MAINTENANCE FIELD

A maintenance related message is downloaded to the RS-232-C port whenever the maintenance field changes value. It is displayed in the following format:

09/17/92 12:22:30 SLC MTCE: TEST ALARM RC (if message is sent by the RT)
09/17/92 12:22:30 SLC MTCE: TEST ALARM CR (if message is sent to the RT)
09/17/92 12:23:12 SLC MTCE: IDLE

The maintenance messages sent by the RT are as tabulated in the right hand column. The left hand column shows these messages as they are displayed by the VFDT.

| | |
|---|---|
| SEIZED/PROCEED RC | S/PRC |
| SEIZE RC | SRC |
| PROCEED RC | PRC |
| TEST ALARM RC | TSTALM |
| IDLE | IDLE |

The maintenance messages sent to the RT are as tabulated in the right hand column. The left hand column shows these messages as they are displayed by the VFDT.

| | |
|---|---|
| ON-HOOK/PROCEED CR | ON/PCR |
| ON-HOOK | ON/H |
| PROCEED CR | PCR |
| TEST ALARM CR | TSTALM |
| IDLE | IDLE |

### 10.5.2 PROTECTION SWITCH MESSAGES

A protection switch related message is downloaded to the RS-232-C port whenever the protection field changes value. It is displayed in the following format:

12:22:30 09/17/92 SLC PLS: B-XMT/RCV
12:23:12 09/17/92 SLC PLS: IDLE

The downloaded protection switch messages are as tabulated on the left hand column below. The right hand column shows the corresponding abbreviations displayed by the VFDT.

| | |
|---|---|
| IDLE | IDLE |
| Switch Line A Receive | A-R |
| Switch Line B XMT | B-X |
| Switch Line C XMT | C-X |
| Switch Line D XMT | D-X |
| Switch Line B XMT and RCV | B-XR |
| Switch Line C XMT and RCV | C-XR |
| Switch Line D XMT and RCV | D-XR |

### 10.5.3 SLC-96 ALARMS

A SLC-96 alarm message is downloaded to the RS-232-C port whenever alarms are set or cleared. They are displayed utilizing the following format:

09/17/92 12:22:30 SLC ALARM CHANGE
MAJOR ALARM SET

09/17/92 12:22:35 SLC ALARM CHANGE
MINOR ALARM SET

09/17/92 12:22:45 SLC ALARM CHANGE
A-LINE FELP SET

09/17/92 12:23:12 SLC ALARM CHANGE
A-LINE FELP CLEARED

The downloaded alarm messages are listed below.

| | | |
|---|---|---|
| MAJOR ALARM | B SHELF ALM | B LINE FELP |
| MINOR ALARM | C SHELF ALM | C LINE FELP |
| POWER/MISC AIARM | D SHELF ALM | D LINE FELP |
| A SHELF ALARM | A LINE FELP | P LINE FELP |

### 10.5.4 SLC CONCENTRATOR FIELDS

The 235A test set uses the printer port to keep track of call blockage. When the 235A is monitoring the FROM RT side of the data link, it keeps track of the subscriber lines that are OFF-HOOK. When more than 24 subscriber lines attempt an OFF-HOOK, the following message is downloaded to the RS-232-C port:

12:23:12 09/17/92 SLC: CALL BLOCKAGE

When the system returns to fewer than 24 active channels, the following message is downloaded:

12:25:05 09/17/92 SLC: BLOCKAGE CLEARED

If the 235A is monitoring the TO RT side of the data link, it keeps track of the number of time slots assigned. If all 24 time slots are assigned, it downloads to the RS-232-C port the following message:

12:23:12 09/17/92 SLC: ALL CHANNELS BUSY

At the transition from 24 active time slots to 23 (a channel returns to ON-HOOK), the following message is downloaded to the printer port:

12:24:19 09/17/92 SLC: TIME SLOTS AVAILABLE

## 10.6 DATA LINK MESSAGE TRANSMISSION

This section describes the DS1 Transmit section DATA LINK key/menu and its operation. This menu allows the user to send specific alarm and protection line switch messages via the data link. This mode of operation is disruptive and can be used either during a system turn up or a repair situation.

To deliver SLC-96 data link messages, the DS1 transmit section must be configured to generate a pattern framed with the SLC-96 format. The type of pattern generated is unimportant. Sending SLC-96 data link messages when the DS1 Transmit operates in the LOOP MODE is not permitted.

Depressing the DATA LINK key causes the display of a screen similar to screen [12].

Screen [12]

```
PLS:IDLE
ALM:NO                PLS ALM
                      #   #
```

This screen shows that the protection line switch (PLS) field is idle and that no alarms are being sent. This screen is referred to below as the root screen.

### 10.6.1 SENDING ALARM MESSAGES

To send an alarm, depress the ALM softkey in screen [12]. This causes the VFDT to display screen [13].

Screen [13]

```
COT-RT/16          COT-RT/13
SLIM                   NXT
                       #
```

This screen enables you to select either the COT-RT/16 format, the COT-RT-13 format, or the SLIM format. This is done by shifting the underline as desired using either pointer key. Depressing the NXT softkey when the COT-RT/16 selection is underlined causes the VFDT to display a screen similar to screen [14a].

Screen [14a]

```
<MAJOR ALARM>   <ALM
567890123456    SET NXT
                #   #
```

The header on the top line gives the assigned alarm name of the underlined position. You can select the desired alarm by shifting the underline with either softkey. Depress the SET softkey to send the selected alarm. While that alarm is being sent, the SET header is replaced by the CLR header. Depressing the CLR softkey clears the alarm. Although several alarms can be sent simultaneously, only one Far End Loop command (FELP) should be sent at one time. Depressing the NXT softkey causes the VFDT to display the root screen anew. If one or more alarms were active when the NXT softkey was depressed in screen [14], the ALM:NO field reads ALM:YES.

Screens [14b] and [14c] are examples of the COT-RT/13 and the SLIM format selections respectively.

Screen [14b]

```
<MAJOR ALARM>   <ALM
234567890123    SET NXT
                #   #
```

Screen [14c]

```
<B SHELF ALARM> <ALM
58901           SET NXT
                #   #
```

### 10.6.2 SENDING PROTECTION LINE SWITCH MESSAGES

To send a protection line switch command, depress the PLS softkey in screen [12]. This causes the VFDT to display screen [15].

Screen [15]

```
A-RCV  B-XMT  C-XMT
D-XMT              GO  NXT
                   #   #
```

This screen shows the first four protection line switch commands (out of a total of seven). To select and send one of these commands, shift the underline to the desired selection and depress the GO softkey. This causes the GO header to be replaced by a blinking STOP header. The blinking indicates that the message is being steadily sent. Depress the STOP header to stop sending the message. Depressing the NXT softkey causes the VFDT to display screen [16].

Screen [16]

```
B-XMT/RCV  C-XMT/RCV
D-XMT/RCV          GO NXT
                   #   #
```

This screen operates in the same manner as the previous one; it provides for the sending of the remaining three protection line switch messages. Depressing the NXT softkey causes the VFDT to display the root menu.

**Note**

When sending an alarm or a protection line switch message, the maintenance and the concentrator bits are set to 1.

# CHAPTER 11
## USING THE AUXILIARY JACKS AND CONNECTORS

### 11.1 INTRODUCTION

This chapter describes the purposes served by the bantam jacks (J11 and J13) and by the D-type connectors (J12 and J14) located on the 235A right hand side panel. Application information relevant to these connectors is also included.

### 11.2 RS-232-C PORT (J14)

In addition to serving as a communication port with RS-232-C compatible printers and terminals, this 25 pin D-type connector accesses several circuit nodes in the 235A. Details are provided in Paragraphs 11.2.1 through 11.2.3.

#### 11.2.1 J14 Pin Assignments

Table 11-1 J14 Connector Pin Assignments

| PIN NO. | ID | | DESCRIPTION |
|---|---|---|---|
| 2 | TXD | * | Transmitted Data output) |
| 3 | RXD | * | Received Data (input) |
| 4 | RTS | * | Request to Send (output) |
| 5 | CTS | * | Clear to Send (input) |
| 6 | DSR | * | Data Set Ready (input) |
| 7 | GND | | Signal Ground |
| 9 | DLCK | | 4kHz Data Link Clock (output) |
| 10 | XFBTO | | Transmit Framing Bit 0 (output) |
| 13 | REFCK | | Reference Receiver Clock (output) 1.544 MHz nominal |
| 20 | DTR | * | Data Terminal Ready (output) |
| 22 | EXT_DLI | | 4 kb/s External Data Link (input) |
| 23 | EXT_DAT_SEL | | External Data Select (0 = true) |
| 24 | RCK | | Diagnostics Receiver Clock (output) 1.544 MHz nominal |
| 25 | EXT_CLK | | External DS1 Transmitter Clock (input) 1.544 MHz nominal |
| All others | | | Not used |

The RS-232-C port is wired as a DTE. Consequently, a null modem cable must be used when using most printers. When using a modem, a plain, one-for-one cable is required. All the signals with an * are related to the RS-232-C port. The logic states for these signals is as listed below :

logic state '0' => +10 Volts nominal.
logic state '1' => -10 Volts nominal.

All the other signals have logic states defined below :

logic state '0' => 0 Volt nominal.
logic state '1' => +5 Volts nominal.

Additional information concerning the use of the RS-232-C port is given in Chapter 12.

### 11.2.2 T1 Clock Inputs and Outputs

J14 pins 13 and 24 respectively supply a copy of the clock recovered from the DS1 Ref INPUT PCM and the DS1 Receive INPUT PCM. J14 pin 25 is the external clock input to the DS1 Transmit section. When a clock is applied to this pin with respect to digital ground (pin 7), this clock is used as master clock by the Transmit if the clock selection is EXT. Additional information is provided in section 5.2.2.

Connecting together J14 pins 13 and 25 allows the DS1 Transmit to use the clock recovered from the PCM applied to the Ref PCM INPUT jack as the master clock.

### 11.2.3 External Data Link Input

When J14 pin 23 (EXT_DAT_SEL) is left unconnected, the ESF 4 kb/s data link content is normally an all-ones message. When, on the other hand, J14 pin 23 (EXT_DAT_SEL) is tied to ground, the content of the data link is supplied by the 4 kb/s bit stream presented at J14 pin 22. To obtain correct clocking-in of the data, the signal presented at J14 pin 22 must be supplied by a source delivering each data bit following the leading edge transition of the 4 kHz clock supplied at J14 pin 9.

## 11.3 AUX DS1 OUT JACK (J11)

A copy of the PCM signal presented at the DS1 Receive Diagnostics section PCM INPUT jack is available at J11. The PCM signal supplied at J11 has a nominal level of 0 dBDSX when terminated in a 100 Ohm load. In effect, the DS1 Receiver Diagnostics section acts as a bridging repeater whose output is J11.

## 11.4 AUX DS1 IN JACK (J13)

When a PCM signal is supplied to this jack from an external source, the 235A DS1 Transmit section delivers a copy of this signal at the T1 and MON jacks. In effect, the Transmit section acts as a line driver for the signal presented at J13. This may be useful when the 235A is to be used as a CSU or when span line current is to be supplied while isolating the signal source from the line.

J13 nominal input impedance is 100 Ohms; it expects a 0 dBDSX level.

## 11.5 SPAN POWER FEED (J12)

This 9 pin D-type connector is not currently used. It was intended for connecting the span power unit (option 04) before this unit was offered with its own set of connectors/jacks to interface with the span line directly.

## 11.6 USING THE 235A AS A CSU

The 235A can be configured as a CSU when qualifying a transmission path extending from the CO to the customer premises. When the 235A is connected as illustrated in Figure 11-1 it performs all the functions expected from a CSU and provides full PCM transmission monitoring at the same time.

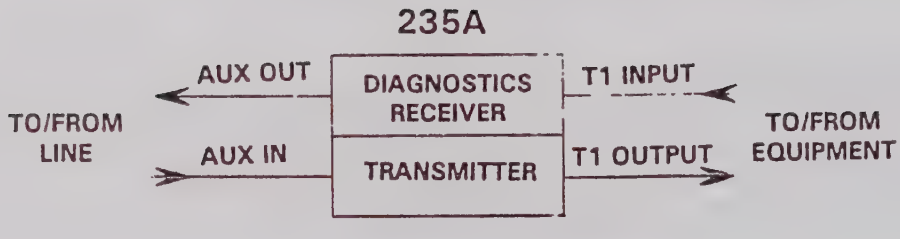



Figure 11-1 Configuring the 235A as a CSU

**Note**

When the 235A is used as a CSU, switch S6 should be set ON. This will allow the 235A to be looped remotely with the CSU/NI loopback codes.

# CHAPTER 12
## USING THE PRINTER INTERFACE PORT (OPTION 02)

### 12.1 INTRODUCTION

When equipped with option 02, the RS-232-C interface provided on the instrument right hand side panel is active and can be used for interfacing a printer or a terminal with the 235A. This capability is primarily intended to enable the down-loading of impairment statistics acquired by the 235A alone or with the 55A add-on module. In this chapter, you will find:

- a description of capabilities provided by the RS-232-C port
- directions for using the RS-232-C interface capability

If the 235A is not equipped with option 02, the content of this chapter is not applicable to the operation of the instrument.

### 12.2 RS-232-C PORT INTERFACE CAPABILITIES

The impairment data obtained and processed by the 235A can be transferred via the RS-232-C port to equipment compatible with the RS-232-C interface standard. This primarily includes printers and PC type terminals. The connection to this equipment can be performed either by cable or via a modem. A limited number of commands can be accepted by the 235A from the terminal via the RS-232-C port.

The data supplied by the RS-232-C port consists of variable length ASCII character strings. This data is formatted to fit within 40 columns.

Section 3.4 in this instruction manual describes a family of menus allowing you to select the data format and the type of flow control provided by the RS-232-C port. Section 11.5 in this instruction manual describes the pin assignment on the RS-232-C connector (J14).

The 235A RS-232-C port can be set-up to operate with the following parameters:

DATA BITS - 7 or 8
PARITY - NONE, EVEN or ODD
STOP BITS - 1, 1.5 or 2
BAUD RATE - 300, 1200, 2400, 4800, or 9600

Flow control type selection can be made by setting DIP switch S2 positions 1 and 2 as listed in the table below.

Table 12-1 Flow Control Selection

| Type | S2/1 | S2/2 |
|---|---|---|
| NONE | OFF | OFF |
| CTS | ON | OFF |
| XON/XOFF | OFF | ON |
| DSR | ON | ON |

The flow control types identified in Table 12-1 are as follows:

NONE: no flow control selected

CTS: the CTS signal (J14/5) must be at state ONE (-10 V) for data to be transferred. If the CTS signal is ZERO (+10 V), flow control is exercised.

XON/XOFF: when an XON character (control-S, ASCII value 13H) is received by the 235A, flow control is exercised. Flow control will continue until the XOFF character (control-Q, ASCII value 11H) is received by the 235A.

DSR: the DSR signal (J14/6) must be at state ONE (-10 V) for data to be transferred. If the DSR signal is ZERO (+10 V), flow control is exercised.

**Note**

**If the 235A is kept in flow control for a long period of time the internal data buffer will over-flow, and data may be lost and/or corrupted.**

**When the T-COM Thermal Printer (P/N) 1470-002) is used with the 235A, the flow control should be set to CTS. A straight RS-232-C cable should be used since the 1470-002 is wired as DCE.**

### 12.2.1 General Messages and Interface Commands

This paragraph describes the messages supplied by the 235A and the commands recognized by this instrument. The commands referred to here must be supplied to the 235A from a keyboard associated with the printer or terminal connected to the RS-232-C port. If your printer does not have a keyboard, you may activate several commands from the PRNT selection in the MODE key/menu. More information on the PRNT selection is found in Section 3.4 of this manual.

**Messages down-loaded by the 235A**

When the 235A has completed the self-test routine initiated at power-up, it delivers the following message:

```
T-COM 235A DS1 TRANSMISSION ANALYZER
   SELF CHECK OK
   DATE : ab/cd/ef  <M/D/Y> -          TIME:gh:ij<HH:MM>
   TYPE H <cr>  FOR COMMAND            INFORMATION(cr = enter key)
```

If any fault is detected by the 235A while carrying out the self-test routine, the SELF CHECK OK line will be replaced with an indication of the fault.

When the H<cr> command is received the 235A delivers the following message:

**235A COMMANDS ARE AS FOLLOWS:**

```
-RESTART      CLEAR ALL COUNTERS AND RESET ELAPSED TEST TIMER
-T [##]       SET ACTIVITY REPORT TIME PERIOD TO ## MINUTES (1 to 99)
 S-           PRINT SUMMARY REPORT
 R-           PRINT CURRENT RECEIVER STATUS
 VER-         PRINT SOFTWARE VERSION
```

*(Continued)*

## 235A COMMANDS *(Continued)*

| | |
|---|---|
| STR- | PRINT SELF-TEST RESULTS |
| H- | PRINT THIS MESSAGE |
| BTR- | PRINT BRIDGE-TAP TEST RESULTS |
| RTR- | PRINT REPEATER TEST RESULTS |
| P- | PRINT ANSI PRM SUMMARY |
| ES- | PRINT LOCAL ENHANCED 24 HOUR ES REPORT |
| UAS | PRINT LOCAL ENHANCED 24 HOUR UAS REPORT |
| BES | PRINT LOCAL ENHANCED 24 HOUR BES REPORT |
| SES | PRINT LOCAL ENHANCED 24 HOUR SES REPORT |
| COFC | PRINT LOCAL ENHANCED 24 HOUR COFC REPORT |

The last six commands are available only if option 03B, the ESF DATALINK option, is installed. They are also available from the MODE menu.

> NOTE
> TYPE <CR> (ENTER KEY) AFTER EACH COMMAND

If any unlisted command is entered, the 235A sends the following message:

COMMAND <INPUT COMMAND> NOT FOUND - H <CR> FOR HELP

where <INPUT COMMAND> was the command typed in.

The receipt of a RESTART command by the 235A causes the clearing of all the impairment counters and restarts the elapsed test timer. The 235A then responds with:

THE 235A HAS BEEN RESET.

and starts sending its activity report.

The T [##]<cr> command allows you to set the period of the activity report. The [##] is a number in the range 1 to 99 minutes. The T [##] command performs the same function as the PRNT REPRT TMR screen [20] in Section 3.4.

The S<cr> command causes the 235A to down-load the summary report for the current test. This command is the same as the SUM. REPORT command entered from screen [18] in Section 3.4. The content and format of the report are described in Section 12.2.3.

The R<cr> command causes the 235A to down-load a status report about the current state of the receiver. This command is the same as the RCVR STATUS command entered from screen [19] in Section 3.4. The format of this report is described in Section 12.2.4.

The VER<cr> command causes the 235A to down-load the software version number and date at which it was released. This command cannot be supplied from the MODE menu and is thus not available with a receive-only terminal.

The STR<cr> will cause the 235A to down-load the results of the power-on self-test. This report lists each type of error and any error counts that occurred during the self-test. This command cannot be supplied from the MODE menu and is thus not available with a receive-only terminal.

The **BTR<cr>** command causes the 235A to down-load the results of the Bridge Tap Test when the 235A is equipped with option 05 and a test has been run. The results of the most recent test are printed.

The **RTR<cr>** command causes the down-loading of the Repeater Stress Test when the 235A is equipped with option 05 and a test has been run. The results of the most recent test are printed.

The **USER<CR>** command displays the value of the selected long USER defined pattern one byte at a time and allows you to change it. Upon entering this command the 235A will identify the selected USER defined code. To edit a particular code, i.e. USER-3, the code must be selected on the 235A transmitter. Entering a <CR> will cause the next byte to be printed. Entering a P<CR> will cause the previous byte to be printed. To change the value of the byte, enter the new value. Entering an X will blank out the present byte and all subsequent bytes thus truncating the pattern. Entering a . will exit the command. Option 03 or 03A must be installed to use this command.

**Note**
The following commands are available only if option 03B is installed.

The P<CR> command causes the ANSI PRM summary report to be downloaded.

The ES<CR> command causes the enhanced 24 hour errored second report to be downloaded.

The UAS<CR> command downloads the enhanced 24 hour unavailable seconds message.

The BES<CR> command causes the enhanced 24 hour burst errored seconds report to be downloaded.

SES<CR> is the command to print the enhanced 24 hour severely errored seconds results.

The COFC<CR> command causes the 24 hour controlled slip second / loss of frame count to be printed.

The **LINE1 "message"<CR>** and **LINE2 "message"<CR>** commands allow the 235A power up message on the VFDT to be customized. The message is a string of up to 20 characters which must be enclosed in quotes. For example, entering the command LINE1 "I LOVE MY 235A" will cause this message to be displayed on the top line of the VFDT upon power up.

### 12.2.2 The Activity Report

Activity reports are automatically sent by the 235A. The first report takes place shortly after the 235A has successfully executed the self-test routine. Each activity report contains a record of all impairment or alarm activity detected over a selected time period. This period is set by using the T [##] command described above or from the MODE menu as described in Section 3.4 of this manual.

Activity reports are test-independent; if a test is stopped as a result of time-out or the removal of a plug from the PCM INPUT jack, activity reports continue to record all events, even though all test error counters have stopped.

Activity reports reflect :

-RCVR JACK status
-REF JACK status
-BPV count
-CRC ERROR count
-FR BIT ERR count
-ERR-SEC count
-SES count
-CSES count
-FR LOSS-SEC count
-AIS SEC count
-YEL ALARM SEC count
-BIT ERR count
-SYNC LOSS-SEC count
-SLIP CNT count
-MANUAL RESTART entry

After 24 lines of data have been sent, the heading is resent preceded by 3 blank lines.

A sample activity report is shown in Table 12-2. It reflects the following conditions:

**Table 12-2 Sample Activity Report**

| DATE | TIME | EVENTS | COUNTS |
|---|---|---|---|
| 3/7/91 | 10:13 | REF JACK | OUT/IN |
| 3/7/91 | 10:14 | CRC ERR | 1 |
| | | ERR-SEC | 1 |
| 3/7/91 | 10:18 | FR BIT ERR | 4 |
| | | ERR-SEC | 1 |
| 3/7/91 | 10:21 | FR BIT ERR | 1 |
| | | ERR-SEC | 1 |
| 3/7/91 | 10:22 | FR LOSS-SEC | 2 |
| | | SES | 2 |
| 3/7/91 | 10:30 | FR LOSS-SEC | 3 |
| | | SES | 3 |
| | | CSES | 1 |

The test data recorded in Table 12-2 started at 10:12 with patch cords plugged into the RECEIVE INPUT jack and the REF INPUT jack. The selected time period was one minute. Consequently, a line item is printed only if one or more events occurred during the previous minute.

Between 10:12 and 10:13 two events occurred :
- the patch cord was first pulled out of the REF INPUT jack
- the patch cord was then reinserted.

Between 10:13 and 10:14, one CRC error occurred; it resulted in one errored second

The traffic was unimpaired between 10:15 and 10:17.

At 10:17, 4 frame bit errors occurred within one second causing an errored second.

The traffic was unimpaired between 10:18 and 10:20.

Between 10:20 and 10:21, 1 frame bit error occurred causing an errored second.

Between 10:21 and 10:22, the 235A lost frame for 2 seconds. This caused 2 seconds of FRAME LOSS and 2 SESs.

The traffic was unimpaired between 10:23 and 10:29.

Between 10:29 and 10:30, there were 3 consecutive seconds of frame-loss, causing 3 SESs and 1 CSES.

> **Note**
> Since Activity reports are automatically sent by the 235A, they may print over a command which you are entering at the time the report is downloaded.

### 12.2.3 The Activity Summary Report

As previously noted, activity summary reports are down-loaded whenever the S <cr> is sent to the printer interface port of the 235A, or whenever generated from the MODE keys PRNT menu. Table 12-3 shows a sample summary report. The heading includes the current date and time, and the elapsed test time.

**Table 12-3 Sample Activity Summary Report**

ACTIVITY SUMMARY

DATE : 06/05/91 TIME :16:15:20
TEST TIME : 0:01:23
TEST HAS BEEN STOPPED DUE TO REMOVAL OF RECEIVER PLUG
RECEIVER PLUG IN
REFERENCE PLUG OUT
TRANSMITTER IS IN LOOP MODE

| EVENTS | COUNTS |
|---|---|
| BPV | 125 |
| ERR-SEC | 41 |
| EFS | 42 |
| % EFS | 50.60 |
| CRC ERR | 12 |
| FR BIT ERR | 4 |
| FR LOSS-SEC | 3 |
| AIS SEC | 1 |
| REM ALARM-SEC | 0 |
| BIT ERROR | N/A |
| SYNC-LOSS-SEC | N/A |
| BER | N/A |
| FRAME BER | $3.2 \times 10^{-8}$ |
| BPV BER | $3.2 \times 10^{-8}$ |
| CRC BER | LOW ERROR |
| SLIP | 2 |
| END SUMMARY | |

Notes:

- FRAME BER, BER, BPV BER and CRC BER values are computed only if the number of errors in each case exceeds four. If the number of errors is < 4, or the BER calculated is < $0.1 \times 10^{-9}$, LOW ERROR is printed.
- If a BER has a value of > $9.9 \times 10^{-3}$, HIGH ERROR is printed.
- If the test has stopped, due to time-out or removal of the plug from the DS1 Receive INPUT jack, this is noted in the report.
- The N/A entry is sent for BIT ERROR, FR BIT ERR, FR-LOSS SEC, FRAME BER, BER, and SYNC LOSS-SEC if bit pattern synchronization never occurred.
- >999999 is sent for an event count exceeding 999999.
- The CRC and CRC BER events are only included if the system selection during the test was ESF.

### 12.2.4 The Receiver Status Report

As previously noted, the receiver status reports are sent by the 235A whenever the R <cr> command is received via the RS-232-C port or whenever generated from the MODE keys PRNT menu. The receiver status report is a snap shot of what is happening at the receiver.

**Table 12-4 Receiver Status Report**

```
RECEIVER STATUS
DATE: 06/05/91              TIME 16:42

RECEIVER PLUG IN
RECEIVER HAS LOS
FRAME TYPE IS <SF, ESF, SLC-96, NOT-FRAMED>
INPUT FORMAT IS <AMI, B8ZS>,
RECEIVER DOES NOT HAVE PATTERN SYNC
RECEIVER HAS PATTERN SYNC-<PATTERN>
RECEIVER IS RECEIVING > 15 0's
RECEIVER IS RECEIVING < 12.5%
RECEIVER IS RECEIVING AIS
RECEIVER IS RECEIVING YELLOW ALARM

END RECEIVER STATUS
```

In Table 12-4, all possible aspects of the receiver report are shown. Possible values for each item are shown between angle brackets (< >). The heading includes the current date and time.

## 12.3 USING THE RS-232-C INTERFACE PORT

To down-load the transmission statistics processed by the 235A, the RS-232-C port must be patched to a terminal either directly or via a modem and a transmission line.

The terminal may be either a standard line printer providing a receive-only function, a printer with a keyboard providing both send and receive functions or a computer. It may be connected either directly to the 235A or via a pair of modems and a telephone line. In any case, the terminal must be equipped with a serial RS-232-C port.

The interconnecting cable connected to the 235A RS-232-C port must have one-for-one (direct) connection if the port is connected to a modem (DCE), or if the terminal emulates a modem. Otherwise, a null modem cable or adapter as illustrated in Figure 12-1 must be used to connect to the terminal.

To ensure operational compatibility with the terminal, you must ensure that the data format and the flow control type selected on the 235A RS-232-C port are the same ones used on the terminal.

The data format and the flow control type are selected on the 235A from the MODE key/menu as described in Section 3.4 starting with screen [22]. These parameters are stored in battery backed-up memory and need not be re-entered every time the instrument is powered-up.

Once properly connected to the 235A, the printer/terminal is ready to operate as described at the beginning of this chapter.

Printers, cables and miscellaneous adapters complementing your 235A can be obtained from T-COM. Refer to Chapter 15 for description and ordering information.

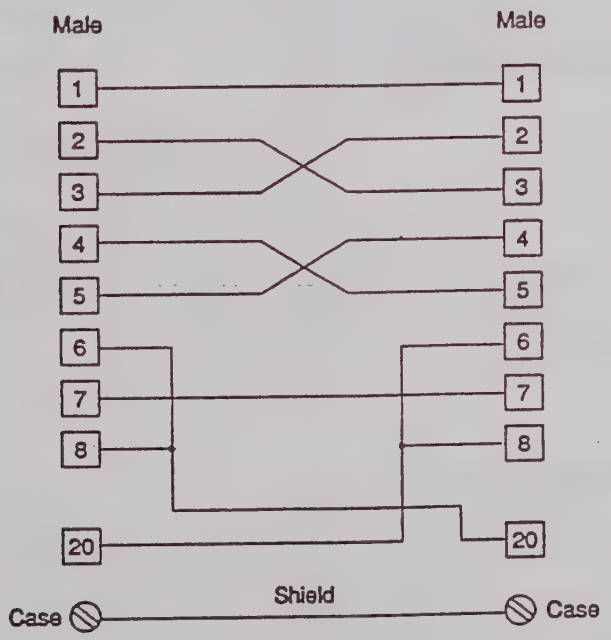



Figure 12-1 Null Modem Adapter/Cable Diagram

# CHAPTER 13
## PERFORMANCE SPECIFICATIONS

### 13.1 INTRODUCTION

This chapter contains the performance specifications for the 235A instrument and its options. Not included are the specifications for option 04, the span power unit. The specifications for the SPU are given in Appendix B.

### 13.2 SYSTEM FORMAT COMPATIBILITY

| | |
|---|---|
| Transmission line code: | T1 (AMI and B8ZS) |
| Channel bank format: | D1D, D2, D3/D4 (SF), ESF and SLC-96 |

### 13.3 DS1 REFERENCE SECTION

| | |
|---|---|
| Input level: | 600 mV pk-pk |
| Input impedance: | 100 Ohm nominal |
| Diagnostics: | LOS (loss of signal) |

### 13.4 DS1 RECEIVE DIAGNOSTICS SECTION

| | |
|---|---|
| Input level: | +3 to -34 dBDSX |
| Input impedance: | 100 Ohm/TERM and MON<br>1000 Ohm/BRDG |
| Diagnostics: | Input overload, LOS, >15 0's, <12.5% 1's density, BPV, Frame bit error, Frame loss, Bit error, AIS, Yellow alarm, loop-up code, loop-down code, and pattern synchronization |
| Framing format: | Auto-selected SF/ESF/SLC-96 |
| Pattern synchronization search: | Automatic or manual |
| PCM output: | T1 nominal 3 V pk in 100 Ohms |

### 13.5 DS1 TRANSMIT SECTION PATTERN

| | |
|---|---|
| Pattern selection: | Framed and unframed $2^{15}$, $2^{20}$, QRS, $2^{23}$, All ones, 1/8, all 0's 1 to 24 bit user defined-code, externally supplied DS1, looped from DS1 Receiver. |
| +(Option 03A): | F-T1, DDS-1 to DDS-4, Long user patterns: 1 to 256 user-defined byte sequences. |
| Framing format: | SF/ESF/SLC-96 (Shelf A) |
| Clock source: | Internal, receiver, external |
| Internal clock source: | 1,544,000 Hz ± 30 Hz |
| Loop code selection: | CSU, NI, 1 to 8 bit user-defined |
| Output level: | 0, -7.5 and -15 dBDSX nominal @ 772 kHz in 100 Ohms |
| External DS1 input: | 0 dBDSX T1 in 100 Ohms |
| Error injection: | BPV, BIT, CRC, FR BIT |
| Error injection rate: | $9 \times 10^{-3}$ to $.1 \times 10^{-9}$ |

| | |
|---|---|
| ESF data link messaging:<br>(Option 03B) | As per ANSI T1.403, and<br>AT&T TR54016<br>Bit oriented messages |
| SLC-96 data link messaging:<br>(Option 03C) | As per Bellcore TR-TSY-00008 |

## 13.6 CONTROLS AND MEASUREMENTS SECTION

| | |
|---|---|
| DS1 statistics: | |
| Counts: | BPV's, frame bit errors, CRC errors, bit errors |
| Seconds: | Errored, severely errored, and consecutive severely errored |
| Bit Error Rates: | BPV BER, FBER, CRC BER and BER |
| Slip: | Bit-by-bit slippage and frame slip count |
| Level measurement accuracy: | ± .2 dB in range +3 to -3 dBDSX<br>± 2 dB in range -8 to -34 dBDSX |
| Frequency measurement accuracy: | ± 10 Hz |
| Line current measurement: | ± 1% in range 50 mA to 160 mA |
| Test time: | Programmable from 0 to 1000 hours |
| ESF data link messaging:<br>(Option 03B) | Decodes/displays ANSI PRM's and<br>AT&T performance messages |
| SLC-96 data link messaging:<br>(Option 03C) | Decodes/displays SLC-96 messages as per<br>TR-TSY-00008 |

RS-232-C INTERFACE PORT (OPTION 02)

| | |
|---|---|
| Access: | 25 pin D-sub female connector |
| Selectable parameters: | Baud rate (300-9600)<br>Data bits (7-8)<br>Parity (Even, odd, none)<br>Stop bits (1, 1.5, 2)<br>Flow control (XON/XOFF, CTS, DSR, None) |

## 13.7 MISCELLANEOUS

| | |
|---|---|
| AC powering: | 108 to 126 VAC, 12 W |
| Battery power (Option 01): | Up to 5 hours nominal on a full charge |
| Battery recharging time: | 16 hours nominal for recharging a fully depleted battery |
| Operating temperature: | 0°C to 50°C |
| Storage temperature: | -40°C to 65°C |
| Humidity: | Up to 90% non-condensation |
| Dimensions: | 7" x 10" x 6" (H x W x D) w/o front cover.<br>The cover adds 1-1/2" to the depth |
| Weight: | 9-1/2 lbs. including detachable front cover, power cable and instruction manual |

## 13.8 54B ADD-ON UNIT

| | |
|---|---|
| VF Decoder: | |
| Channel numbering selection: | D1D, D2, D3/D4, and ESF |
| DS0 channel selection: | Any one of the 24 channels |
| Signaling state decoding: | A,B/SF, A,B,C,D/ESF |
| VF level decoding: | +3.2 to -50 dBm0 |
| Frequency response: | 300 Hz - 3000 Hz within ± .15dB |
| Gain linearity: | 0 to -30 dBm0 => .25 dB |
| Signal to noise ratio: | 0 to -30 dBm0 => 33 dB |
| Idle channel noise: | 13 dBrnC0 max |
| Output impedance: | 600 Ohms nominal |
| DS0 VF measurements: | |
| Level: | +3.2 to -59.9 dBm0 with ± .1 dB accuracy |
| Noise C-MSG with notch: | +10 to +93 dBrbC0 with ± 1 dB accuracy |
| Noise C-MSG: | +10 to +93 dBrnC0 with ± 1 dB accuracy |
| Noise 4 kHz with HP filter: | +10 to +93 dBrnC0 with ± 1 dB accuracy |
| DS0 signaling: | A,B,C,D bits for all 24 channels monitored and displayed simultaneously |
| DS0 Data: | Histogram representing the instantaneous 1/0 density for each bit in the selected channel. Identification of DDS test patterns. |
| Speaker amplifier: | |
| Gain: | 0 to 40 dB gain, continuously adjustable |
| Frequency response: | 300 Hz - 3000 Hz within 3 dB |
| Power: | up to 150 mW |
| Miscellaneous: | |
| Weight: | 2 lbs. |
| Dimensions: | adds 1-1/2" to the 235A front panel height. |

# CHAPTER 14
## FIELD MAINTENANCE AND CALIBRATION

### 14.1 INTRODUCTION

This chapter provides procedures for carrying out routine maintenance as well as the recommended annual calibration of the 235A. These procedures can be carried out by any qualified electronics technician; only standard test equipment and tools are required.

### 14.2 ROUTINE MAINTENANCE

The only routine maintenance recommended in the field is periodic inspection and cleaning of the unit. The maintenance interval should be adjusted based on the condition and usage of the unit.

> **CAUTION**
> BEFORE PERFORMING ROUTINE MAINTENANCE, DISCONNECT THE 235A FROM AC LINE POWER AND TURN ITS POWER SWITCH TO OFF.

1. Inspect all external cords for frayed and broken insulation, particularly at connector terminations.
2. Inspect all connectors on external cords and the exterior of the unit for bent, loose, or missing pins.
3. Inspect the exterior of the unit for missing or loose screws. Replace any missing screws.
4. Dampen a clean, lint-free cloth in a solution of mild soap and warm water and wipe down all of the exterior surfaces of the unit. Allow the unit to dry thoroughly before connecting any cords or turning power on.

### 14.3 CALIBRATION OVERVIEW

There are five adjustments to the 235A that can be performed in the field. All of the adjustments and test points can be accessed by simply removing the top and bottom enclosures of the 235A. The four clocks to be adjusted are at standard TTL levels, 0 and +5V.

The adjustments are:

**Real Time Clock Frequency** - The RTC oscillator drives the internal clock and calendar of the 235A. This frequency can be set very accurately (approximately 1 part in $10^6$) so that any noticeable short-term drift of the RTC can be compensated for.

**6.4 MHz Oscillator Frequency** - This oscillator is used to clock all of the event counters in the 235A. Its frequency can be set to +/- 1 Hz to ensure the measurement accuracy required. It can be checked by inputting a known source of errors to the diagnostics receiver and displaying the error count on the VFDT.

**XMT Clock Frequency** - The XMT Clock is at 1.544 MHz and is used to time the OUTPUT T1 bit stream from the transmitter when selected at the VFDT. It can be adjusted to approximately 1 part in $10^6$.

**RCV Clock Frequency** - The RCV Clock oscillator locks to and tracks the bit rate of the signal applied to the DS1 Receiver INPUT PCM jack. Problems with synchronizing to the input bit pattern may signal the need for making this adjustment.

**RCV Reference Level** - This level is used as a reference against which the level of the INPUT PCM signal to the diagnostics receiver is measured. The measured input level is displayed on the VFDT when the LEVEL & FREQ key is depressed and should be accurate to within +/- 0.05 dB.

Observe the following safety precautions when making the adjustments.

**Span Current Measurement** - This adjustment is made to ensure the accuracy of the span line current measurement.

**WARNING:**
Contact with voltages within the 235A can cause serious injury. Never reach inside the unit with power on. Never work alone. Always have someone nearby who is familiar with current first aid procedures for electrical shock.

**CAUTION:**
Always wear a grounded, conductive wrist-strap when handling printed circuit boards. Static electricity can damage sensitive components.

Always turn power off to the unit when connecting and disconnecting test equipment leads to it. Ensure that all test equipment is properly grounded.

## 14.4 EQUIPMENT REQUIRED

Table 14-1 lists the tools and test equipment required for making the adjustments. Substitute test equipment may be used provided their accuracy is ten times greater than the tolerances specified for each adjustment.

**Table 14-1 Tools and Test Equipment**

| Item | Recommended Model | Qty |
|---|---|---|
| Frequency Counter | HP 5314A Universal Counter | 1 |
| Oscilloscope | Tektronix 2215A | 1 |
| Voltmeter | HP 3468A/B Digital Multimeter | 1 |
| T1 Signal Source | T-COM 515A | 1 |
| Screwdriver | Medium-sized Philips head | 1 |
| Screwdriver | Small slotted-tip | 1 |
| Power Supply | HP E3610A 0-15 V DC | 1 |

## 14.5 ACCESSING THE ADJUSTMENTS

**Top Cover Removal**

The top enclosure of the 235A must be removed to gain access to most of the test points and adjustments. Use the following procedure:

1. Remove the front cover of the unit.
2. Disconnect the power cord from the AC line and turn the POWER switch OFF.

3a. If your 235A is equipped with a 54B add-on module, skip to step 3b, otherwise, proceed as follows. Remove the six Philips head screws, one on each side, one on the top, and three on the back, holding the top enclosure in place (see Figure 14-1). Lift the enclosure off.

3b. If your unit is equipped with an add-on module proceed as follows. Remove the five Philips head screws, one on each side and three on the back, holding the add-on module in place (see Figure 14-2). Lift the enclosure off. Note: When replacing the add-on unit ensure proper seating with the mating connector.

4. Use the reverse procedure to replace the top enclosure.

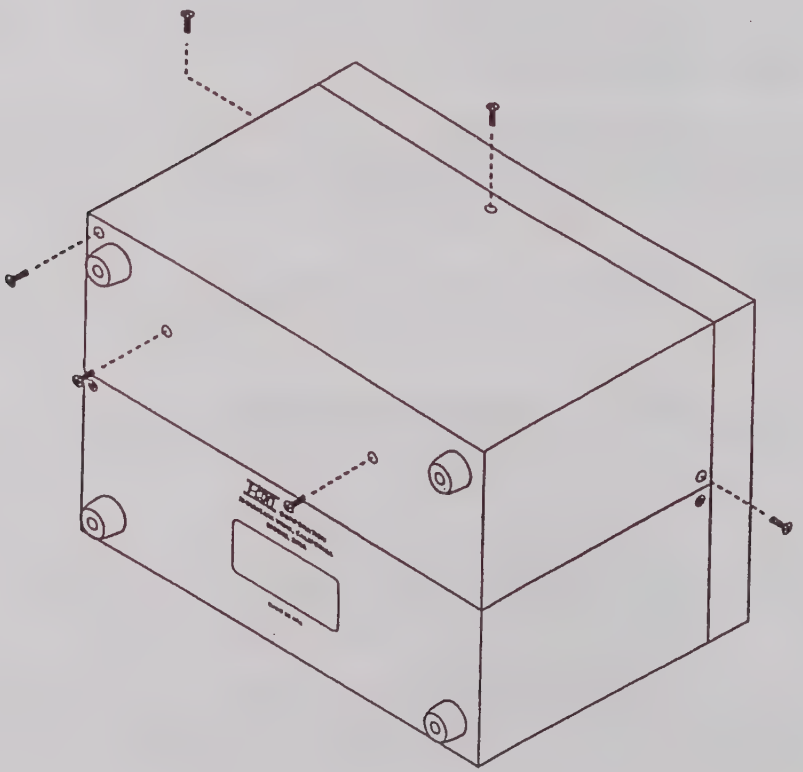


Figure 14-1 Top Cover Removal

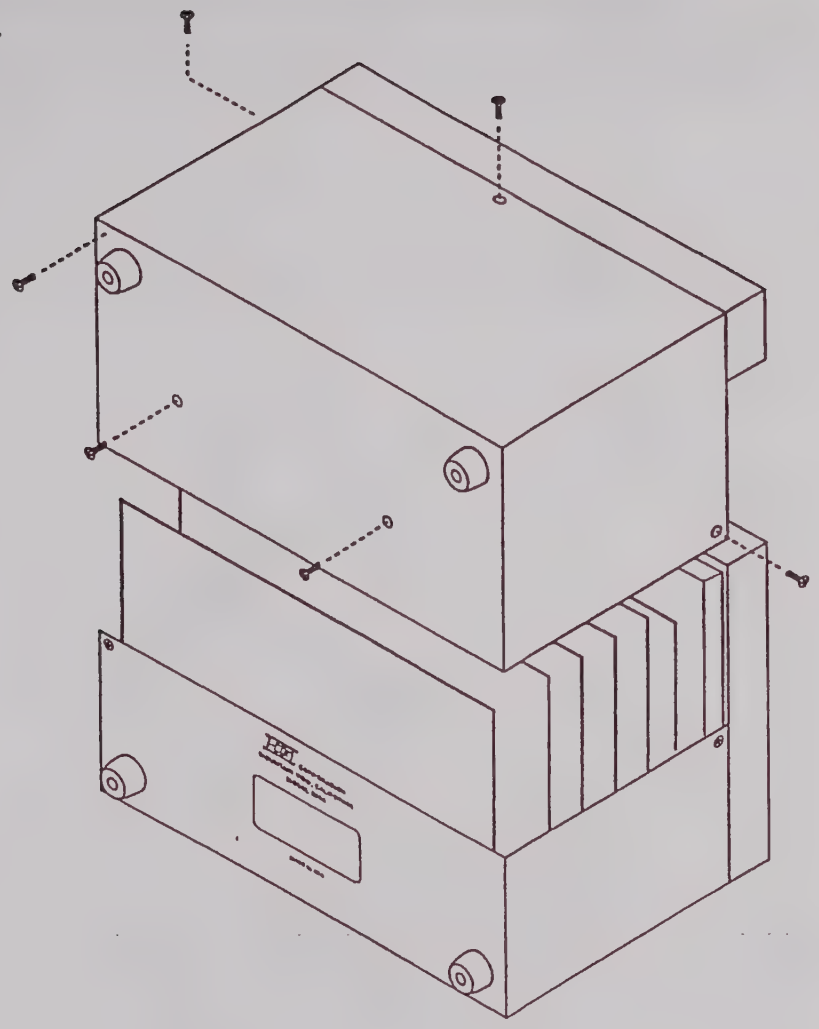


Figure 14-2 Add-on Module Removal

**Bottom Cover Removal**

The bottom cover must be removed from the 235A to access several adjustments. Please follow the procedure below.

1. Remove the front cover of the unit.
2. Disconnect the power cord from the AC line and turn the POWER to OFF.
3. If your 235A is not equipped with option 01, Battery Power, proceed with step 4, otherwise follow the procedure below to remove the Battery Module (See Figure 14-3):

   Turn the 235A upside down and loosen the 4 philips screws which hold the feet of the unit in place. It is not necessary to completely remove these screws. The Battery Module should easily pull away from the 235A.

4. Turn the 235A upside down and loosen the 4 philips screws which hold the feet of the unit in place. It is not necessary to completely remove these screws. Remove the six screws holding the bottom cover in place. See Figure 14-4. The bottom cover should now lift off.

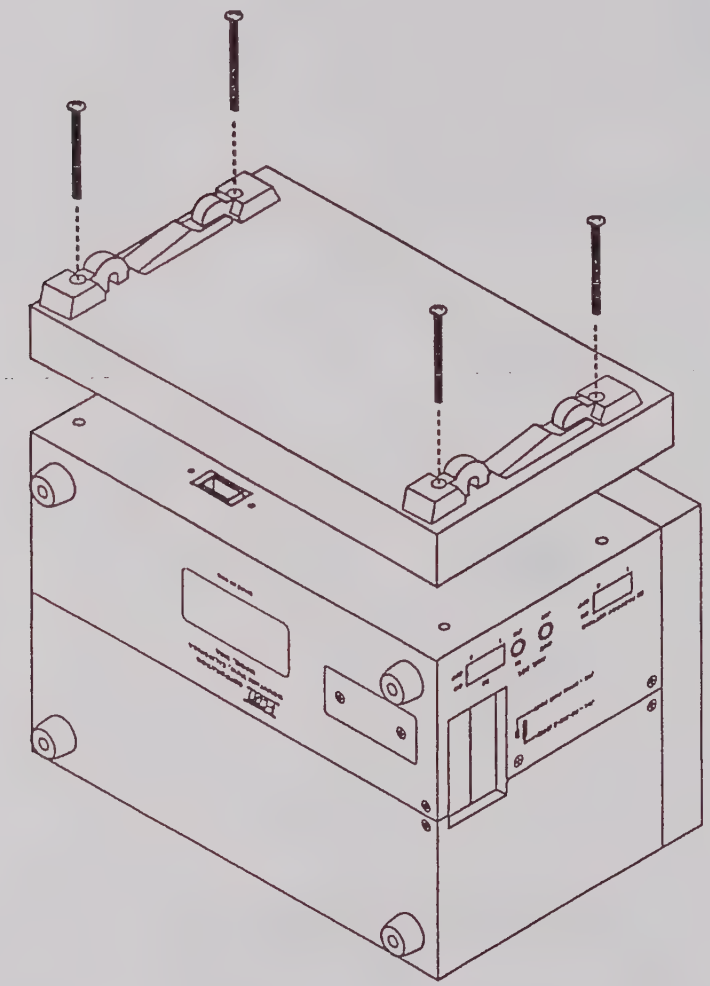


Figure 14-3 Battery Module Removal

## 14.6 CALIBRATION

### 14.6.1 Real Time Clock Frequency

1. Remove the front and top covers of the 235A.
2. Connect the frequency counter to TP5 on the MMC board (see Figure 14-5) and chassis ground (Note: ground may be accessed at M1 on the receiver board).

3. Set position 5 of DIP switch S4 on the right side panel to ON (up).
4. Power up the 235A.
5. Adjust CT2 on the MMC board (see Figure 14-5) for a reading of 64 +/- 0.0001 Hz on the frequency counter.
6. Power down the 235A and disconnect it from the AC line.
7. Disconnect the frequency counter leads from the 235A and replace the top cover.
8. Set position 5 of DIP switch S4 on the right side panel to OFF (down).
9. Power up the unit and set the real time clock and calendar as described in Chapter 3.

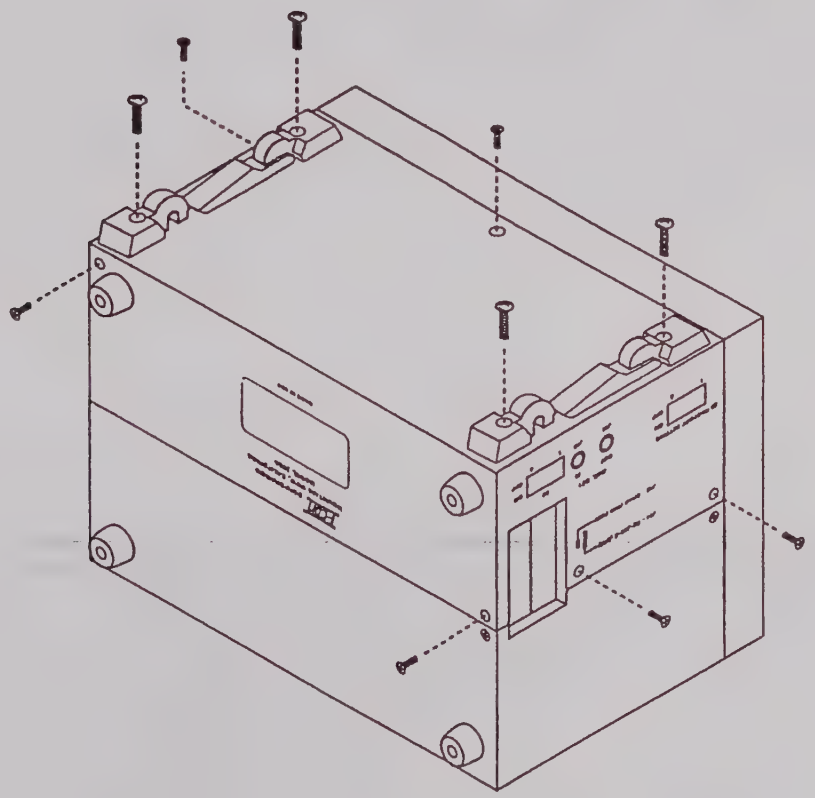


Figure 14-4 Bottom Cover Removal

### 14.6.2 6.4 MHz Oscillator Frequency

1. Remove the front and top covers of the 235A.
2. Connect the frequency counter to TP3 on the MMC board (see Figure 14-5) and chassis ground.
3. Power up the 235A.

4. Adjust CT1 on the MMC board (see Figure 14-5) for a reading of 6.4 MHz +/- 1 Hz on the frequency counter.
5. Power down the 235A and disconnect it from the AC line.
6. Disconnect the frequency counter leads from the 235A and replace the top cover.

### 14.6.3 XMT Clock Frequency

1. Remove the front and top covers of the 235A.
2. Connect the frequency counter to TP1 on the XMT board (see Figure 14-5) and chassis ground.
3. Power up the 235A.
4. Set the transmitter clock to INT on the VFDT (see Chapter 5).
5. Adjust CT1 on the XMT board (see Figure 14-5) for a reading of 1.544 MHz +/- 1 Hz on the frequency counter.
6. Power down the 235A and disconnect it from the AC line.
7. Disconnect the frequency counter leads from the 235A and replace the top cover.

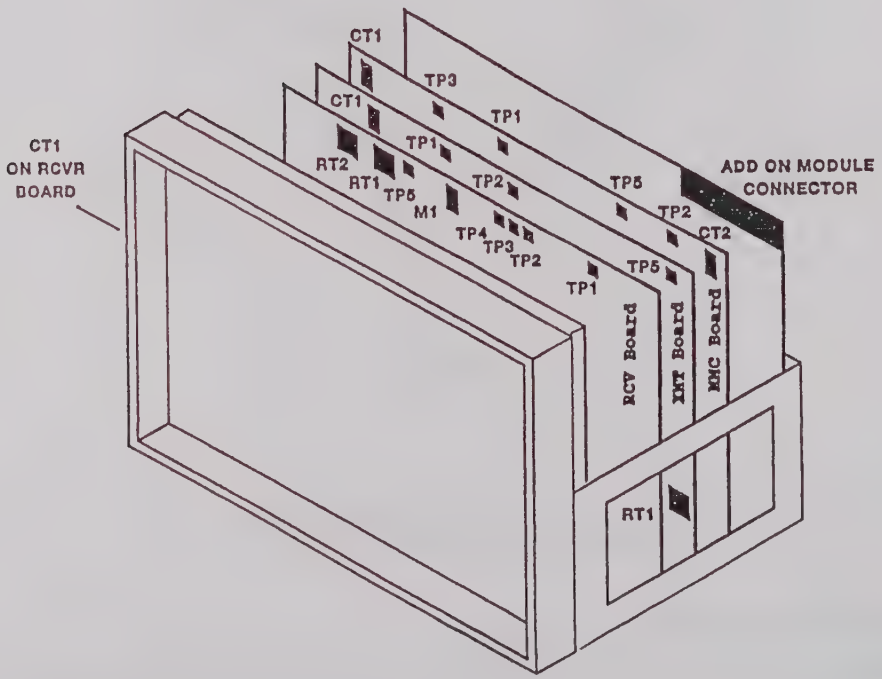



Figure 14-5 Calibration Access Points

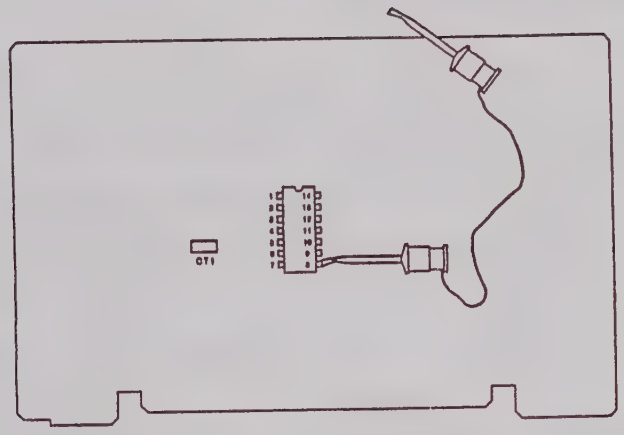



Figure 14-6 Receiver Board Access Points

### 14.6.4 RCV Clock Frequency

1. Remove the front, top and bottom covers of the 235A.
2. Connect the frequency counter to pin #8 or #11 of the IC located at position 2G on the RCV board (see Figures 14-5, 14-6) and chassis ground. To access the pin, remove the Receiver board and place an easy hook connector as shown in Figure 14-6. Ensure that the test lead does not contact any other pins. Replace board in its socket ensuring proper seating. The frequency counter may now be attached to the other end of the easy hook connector.
3. Power up the 235A and ensure that there is no input signal applied to the INPUT PCM jack of the DS1 Diagnostics Receiver.
4. Adjust CT1 on the lower left side of the RCV board (see Figure 14-6) for a reading of 1.544 MHz +/- 100 Hz on the frequency counter.
5. Power down the 235A and disconnect it from the AC line.
6. Disconnect the frequency counter leads from the 235A and replace the top and bottom enclosures.

### 14.6.5 RCV Reference level

1. Remove the front and top covers of the 235A.
2. Connect the positive lead of the voltmeter to TP5 of the RCV board (see Figure 14-5) and the negative lead to chassis ground.

3. Power up the 235A.
4. Adjust RT1 on the RCV board (see Figure 14-6) for a reading of +1.250 +/- 0.001V on the meter.
5. Power down the 235A and disconnect it from the AC line.
6. Disconnect the meter leads from the 235A.
7. Power up the 235A.
8. Set the diagnostics receiver SEL 1 switch to TERM and the SEL 2 switch to DSX.
9. Adjust a T1 signal source to 0 dBDSX (3.0 volts amplitude) on the oscilloscope terminated in 100 Ohms and connect it to the diagnostics receiver INPUT PCM jack.
10. Depress the LEVEL & FREQ key on the Control and Measurements section.
11. Adjust RT2 until the level displayed on the VFDT reads 0.0 dBDSX.
12. Disconnect the T1 signal and remove power from the 235A.
13. Replace the top cover of the 235A.

### 14.6.6 XMTR Span Current Measurement

1. Remove the front and top covers of the 235A.
2. Set up the Digital Multimeter to measure current and connect it between the power supply and pins 1 and 5 of connector J12 on the 235A. See Figure 14-7.
3. Patch the T1 OUTPUT of the 235A to the PCM INPUT and power on the unit.
4. Set the power supply to minimum and turn it on.
5. Slowly increase the power supply voltage until the reading on the ammeter is 100mA.

**CAUTION**
DO NOT INCREASE THE VOLTAGE TO MORE THAN 15 VOLTS

6. Depress the T1 MEAS key, then depress the NXT softkey twice to reveal the Span Line Current screen.

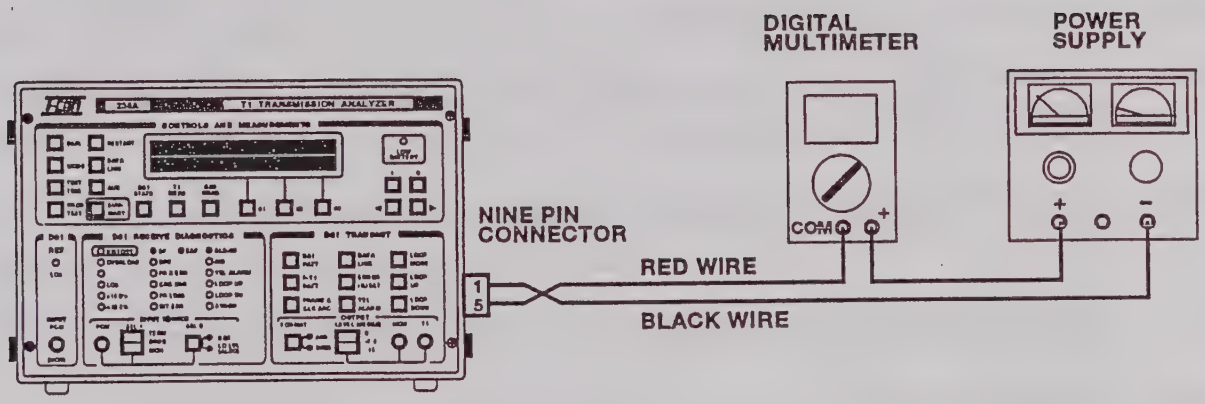



Figure 14-7 Span Current Measurement Calibration

7. Adjust RT1 on the XMTR board ( see fig. 14-5) so that the current reading on the VFDT is 100mA ± 1 mA. See Figure 14-5.

8. Power down the 235A and the power supply and remove the AC power cord. Disconnect pins 1 and 5 of J12 and reassemble the test set.

## 14.7 FINAL STEPS

Once the preceding calibration procedure has been completed verify proper reassembly of the top cover or add-on module, bottom cover and battery pack. Power on the 235A and confirm proper completion of the self test.

If appropriate, place a sticker near the serial number tag on the rear panel to indicate the date of calibration and the next calibration date. If any difficulties arise, please contact T-COM customer service at (415) 964-3415.

# CHAPTER 15
## ACCESSORIES AND REPLACEABLE PARTS

| OPTION | DESCRIPTION |
|---|---|
| 235A/01 | ADD-ON BATTERY PACK |
| 235A/02 | RS-232-C PRINTER PORT<br>Provides printer/terminal or modem interface. |
| 235A/03A | Fractional T1 and Long User Patterns |
| 235A/03B | ESF DATALINK<br>Transmits ANSI messages, AT&T requests, alarms and commands and decodes messages received via the datalink. |
| 235A/03C | SLC-96 DATALINK<br>Transmits datalink alarms, commands, and decodes messages received from the datalink. |
| 234A/04 | SPAN LINE POWER UNIT<br>Powers span and measures span line voltage. Option is installed in the front cover. |
| 235A/05 | PROGRAMMED TESTS<br>Automates repeater stress testing and bridge tap detection. |
| DS0 MONITOR | Add-on module that provides DS0 channel monitoring, signal level and frequency and displays ABCD signaling bits. This unit also dispalys the signaling bit states of all 24 channels simultaneously. |

| P/N | DESCRIPTION |
|---|---|
| *Printer and Cables* | |
| 1470-002 | Printer, battery operated thermal 40/80 column. Equipped with serial & 8 bit parallel ports. 2.1 Lbs. |
| 1700-031 | 6 Ft. male/male RS-232-C cable |
| 2454-008 | AC adapter for printer 1470-002 |
| 2700-032 | 6 Ft. male/male RS-232-C cable with null modem configuration |
| *Soft Cases* | |
| 2888-005 | Canvas carrying case |
| 2888-006 | Canvas carrying case for printer - P/N 1470-002 |

| P/N | DESCRIPTION |
|---|---|
| *Extra Instruction Manuals* | |
| IM235A02 | 235A Extra instruction manual |
| *Miscellaneous Cables and Adapters* | |
| 1690-002 | 4 Ft. Patchcord with bantam & 310 plugs |
| 1690-011 | 8 Ft. Patchcord with nickel-plated bantam & 310 plugs |
| 1690-012 | 8 Ft. Patchcord with nickel-plated bantam plugs |
| 1690-013 | 6 Ft. Patchcord with nickel-plated bantam to RJ48C |
| 1690-014 | 6 Ft. Patchcord with nickel-plated bantam to alligator clip |
| 1690-015 | 6 Ft. Patchcord with nickel-plated bantam to mini hook |
| 1690-016 | 6 Ft. Patchcord with nickel-plated bantam to DB15 |
| *Adapters* | |
| 1694-001 | Bantam-to-310 adapter plug |
| 1694-004 | 100 Ohm termination plug -310 |
| *Kits* | |
| 2889-004 | 235A Cable accessory kit; consists of: two 1690-012; two 1690-013; one 1690-014; one 1690-015; one 1690-016 |

# CHAPTER 16
# INSTALLATION

## 16.1 INTRODUCTION

This section contains a set of instructions for conducting the initial inspection of the newly received 235A and for installing various accessories and options. Also included are repacking and shipping instructions.

## 16.2 INITIAL INSPECTION

When you receive your new 235A T-GUN, carefully unpack it. Do not destroy or discard the packing container and materials. Inventory the contents of the container against the packing slip. Inspect the equipment for any obvious mechanical shipping damage. Plug the 235A in, turn it on, and verify that it completes its self-diagnostic routine successfully (see Section 3.3).

If you suspect that the unit sustained damage during shipment, call the carrier immediately and make a claim. The carrier will want to inspect the unit and its shipping materials. In the event of incomplete contents, mechanical damage or if the instrument does not successfully complete the self-diagnostic routine, notify your T-COM sales representative or T-COM customer support at (415) 964-3415.

## 16.3 FIELD INSTALLATION OF OPTIONS

Most of the 235A options can be installed in the field by people having a minimal amount of mechanical skills. Installation information for options 01, 03, 04, and 54B are provided below. Table 16.1 identifies each option and whether it is field retrofittable.

> **CAUTION**
> When performing any of the option installation procedures given below, the set must be disconnected from the AC power line. Failure to comply with this requirement can result in harm to the operator and/or the test set.

Table 16-1 Identification of the 235A Options

| Option | Description | Field Retrofittable |
|---|---|---|
| 01 | Battery Powering Module | Yes |
| 02 | Printer Interface Port | No |
| 03A | F-T1, and Long User Patterns | Yes |
| 03B | ESF Datalink | Yes |
| 03C | SLC-96 Datalink | Yes |
| 04 | Span Powering Unit | Yes |
| 05 | Programmed tests | No |
| 54B | DS0 Channel Monitor Unit | Yes |

The Printer Interface Port and the Programmed Tests options require a circuit card with special firmware and cannot be upgraded in the field.

### 16.3.1 Battery Powering Option Installation

The Battery Powering Unit is a battery pack that installs on and plugs into the bottom cover of the 235A. Only a medium-size philips head screwdriver is required. Proceed as follows:

1. Disconnect the 235A from AC line power and set its POWER switch on the left hand side to OFF.
2. Lay the 235A on its top on a bench and remove the four philips head screws securing the feet to the bottom cover.
3. Remove the two philips head screws holding the connector cover plate in place at the bottom of the unit and remove the cover plate. Using the same screws, secure the cover plate to the rear panel of the unit at the location shown in Figure 16-1.
4. Carefully install the battery pack on the bottom of the unit ensuring that the connectors on the unit and the battery pack mate squarely without bending pins in the connector. See Figure 16-2.
5. Install the four long philips head screws supplied with the battery pack through the feet on the pack and into the bottom of the 235A. Tighten the screws firmly.
6. Plug the unit into the AC line and let the battery charge for a period of 10 to 14 hours before using it. (The battery is charged whether the 235A POWER switch is ON or OFF.)
7. Verify that the instrument is powered by the battery, by disconnecting the AC power cable from the 235A and setting the POWER switch to ON. Verify that the instrument completes the self-test sequence successfully.

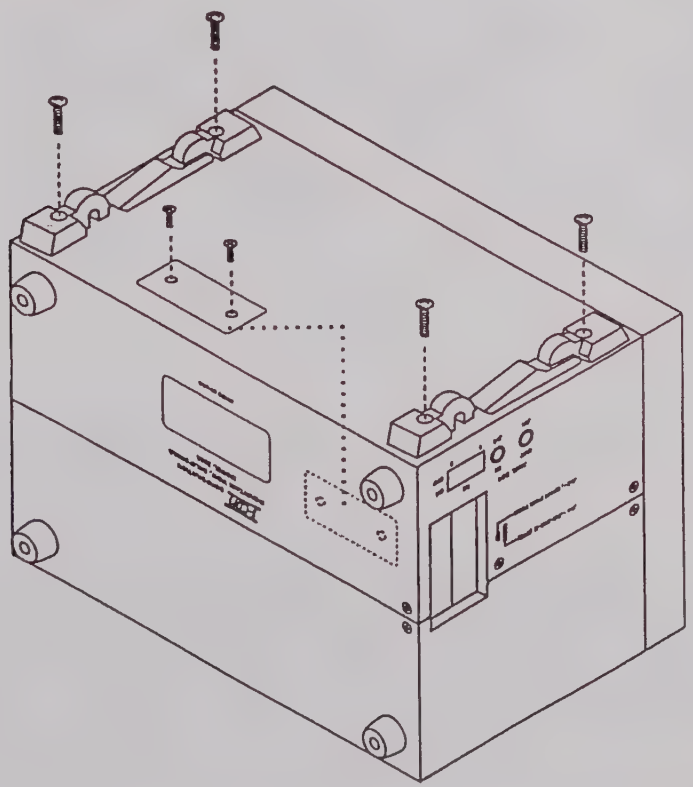


Figure 16-1 235A Feet and Battery Connector Plate Removal

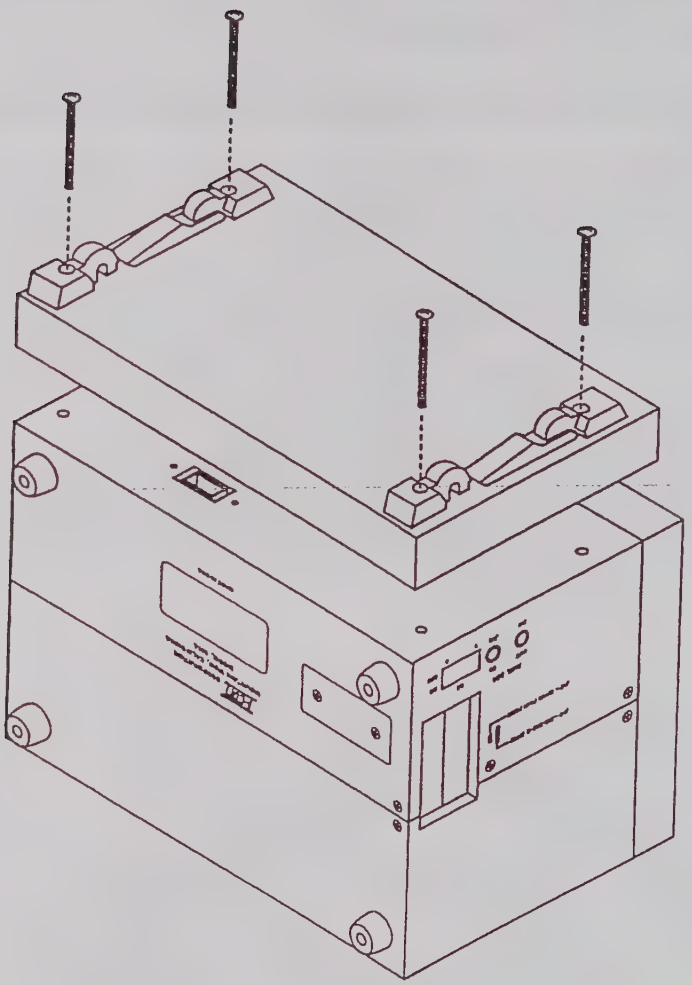


Figure 16-2 Battery Powering Option Installation

**NOTE:**
When fully charged, the battery pack should power the 235A for approximately five hours with the VFDT turned off. If the VFDT is continually lit, the battery can power the instrument for only about two hours. When powered by the battery, the VFDT is automatically turned off if no front panel keys are depressed for one minute. The VFDT is turned on by again depressing any key.

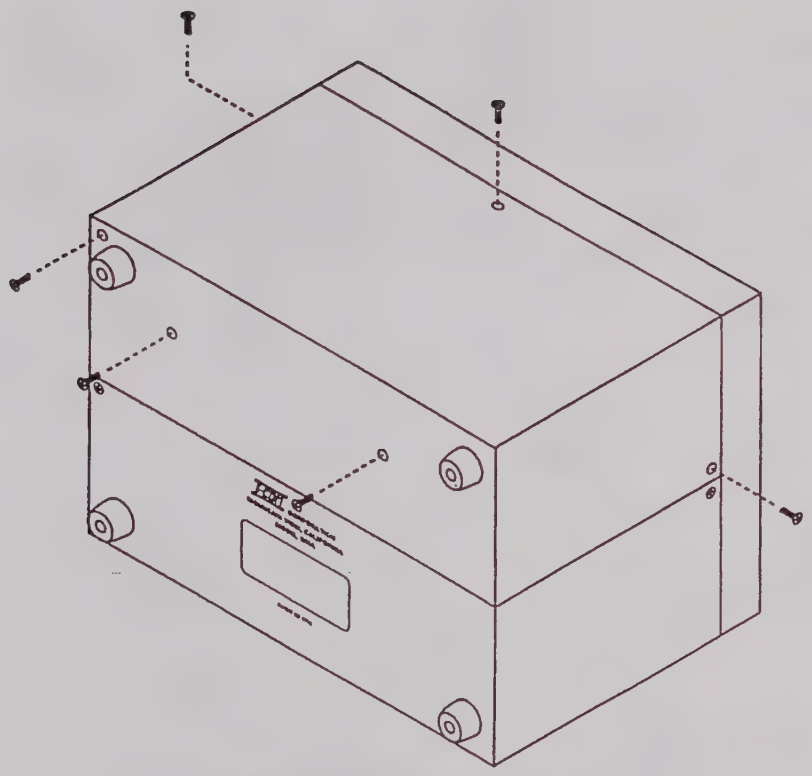


Figure 16-3 235A Top Cover Removal

### 16.3.2 Installation of Option 03

The installation of the F-T1/Long User Patterns option 03A, ESF data link messaging option 03B, or SLC-96 data link messaging option 03C, consists in installing a PC board assembly in the 235A mother board option slot. This is accomplished by carrying-out steps 1 through 6 below and requires only a medium-size philips head screwdriver.

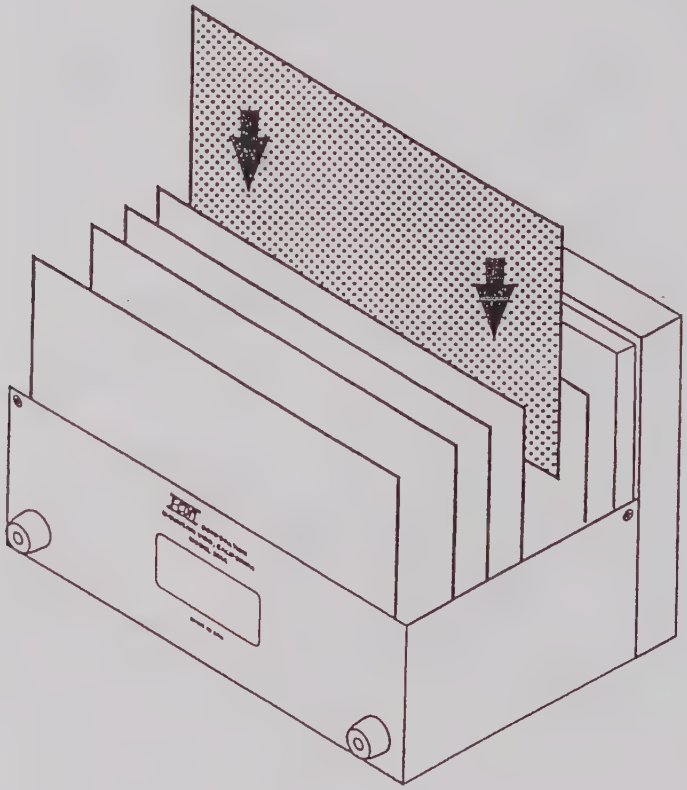


Figure 16-4 Option 03 Installation

1. Disconnect the 235A from AC line power.
2. Remove the five philips screws securing the top cover to the 235A and pull the cover away from the unit. See Figure 16-3.
3. Remove the option board from its protective bag and insert the board into the vacant slot located near the front of the instrument (component side facing the front of the instrument). Make sure that the option board is properly secured in the connector. See Figure 16-4.
4. Install the top cover back on the instrument and secure it in place with the five screws retaining it originally.
5. Identify the addition of option 03A, B or C on the instrument serial number tag.
6. Verify that the option is functional by letting the instrument complete its self-test routine successfully.

### 16.3.3 Installing the Span Powering Option

The Span Power Unit P/N 2454-006 is contained in a modified front cover for the 235A. Its installation requires only its substitution for the front cover normally supplied with the 235A. No tools or assembly are required.

### 16.3.4 Installing Option 54B

To install the DS0 Channel Monitor Unit, the 235A top cover must be removed and replaced by the optional add-on unit. This is accomplished by carrying-out steps 1 through 5 below and requires only a medium-size philips head screwdriver.

1. Disconnect the 235A from AC line power.
2. Remove the five philips screws securing the top cover to the 235A and pull the cover away from the unit. Figure 16-3.
3. Remove the add-on unit from its protective bag and place it gently on the top of the instrument making sure that the connector mating the DS0 Channel Monitor Unit with the power supply board is properly aligned. Push down on the top of the 54B until it takes the same position as the regular top cover. See Figure 16-5.
4. Secure the add-on unit in place with the five screws previously retaining the top cover.
5. Verify that the option is functional by letting the instrument complete its self-test routine successfully.

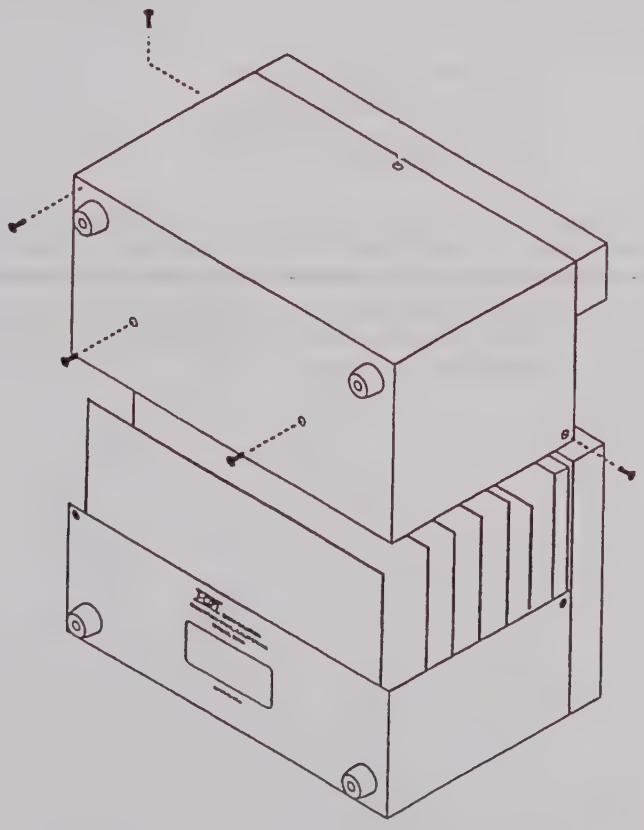


Figure 16-5 Add-on Module Installation

**Remark:**
Before installing a new option on your 235A, it is wise to inquire with the T-COM factory whether your instrument requires a software upgrade or any other changes not listed above to ensure compatibility with the new option. Make your request by phone or fax to T-COM's customer service. You will be requested to supply the serial number for the 235A you wish to upgrade.

Phone: (415) 964-3415
Fax : (415) 964-3958

## 16.4 REPACKING FOR SHIPMENT

The use of the original shipping carton and packing material is highly recommended. If the original packing material is not available, you may use any strong container. Wrap the instrument in heavy paper or a plastic bag and surround it with three or four inches of shock absorbing material to cushion it firmly and prevent movement inside the container.

**Note**
Your authorized T-COM representative is ready to assist you in any situation and you are always welcome to get directly in touch with the T-COM service department:

Customer Service T-COM
825 E. Middlefield Road
Mountain View, CA 94043
Tel: (415) 964-3415

All equipment returned to the factory must be accompanied by a Return Material Authorization (RMA) number. This number will be issued to you upon calling the above phone number. Be prepared to give the serial number and a description of the problems you are encountering with the instrument. Please, reference the RMA on both the packing slip and the purchase order associated with the equipment. Include with the instrument a comprehensive description of the encountered problem(s) to ensure that the instrument is satisfactorily repaired.

# CHAPTER 17
## WARRANTY

The T-COM 235A is warranted against defects in materials, software design and workmanship for a period of two years from the date of shipment. Under this warranty, T-COM will repair at no charge any product defect or failure not resulting from misuse, negligence, accident or unauthorized repairs or modifications.

New software based features will be provided at no charge for a period of six months after the original date of shipment if the new software requires no hardware changes to the unit and the features are provided free of charge in later issues of the product.

T-COM does not assume any liability for consequential damages. We reserve the right to make changes in design and construction of our products at any time without incurring any obligation to alter units previously sold.

This warranty is in lieu of any other warranty expressed or implied except as specifically modified in writing by an officer of T-COM.

**Notes:**

- With the exception of transportation costs, there is no charge for repair of instruments under warranty.
- Estimates of charges for non-warranty or other service work will always be supplied, if requested, before work begins.

# APPENDIX A
## HARDWARE & SOFTWARE VERSION HISTORY

| Hardware VERSION | REASON FOR ISSUE |
|---|---|
| 2.2 | Initial release. |
| 2.3 | Time & Date modification. |
| 2.4 | Power Supply modification. |
| 2.5 | New front panel and modifications to accept software version 2.4 and Option 03. |
| 3.3 | New power supply & old front panel. |
| 4.0 | New power supply & new front panel. |

| Software VERSION | |
|---|---|
| 2.2 | Initial software release. |
| 2.3 | Intermediate release. For T-COM use. |
| 2.4 | Implementation of customer requested screen and front panel modifications. These include a SUMMARY key, a single RESTART key, T1 voltage level measurement and simultaneous error injection and error counting screen among several other desired enhancements. |
| 2.5 | Addition of ESF datalink messaging capability, ALL 0s test pattern, HISTORY reset. |
| 2.6 | Addition of SLC-96 datalink messaging capability. B8ZS MEMORY added. |
| 2.7 | Clearing software design faults causing occasional:<br>- datalink memory overflow<br>- framing error |

# APPENDIX B
## SPAN POWER UNIT P/N 2454-006

### B.1 INTRODUCTION

The span power unit P/N 2454-006 is an accessory to the 235A. It is housed in the front cover of the instrument and can be used independently from it. The span power unit (SPU) provides a convenient means to power a T1 span line before the span terminating equipment is available.

This chapter is divided into six sections. They provide:

- a general description of the SPU
- operation description of every feature
- safety considerations
- application information
- a circuit diagram of the SPU/span line interface
- complete specifications for the SPU

Figure B.1 illustrates the front panel of the span power unit.

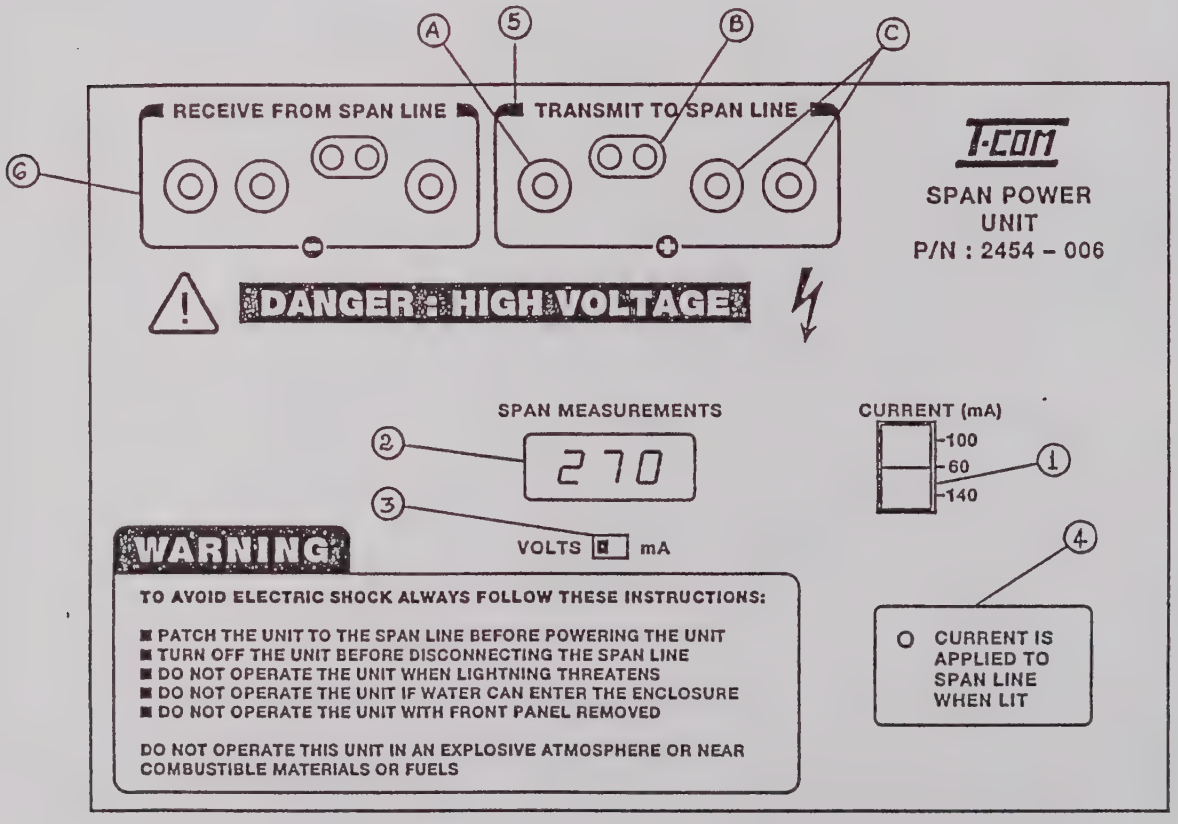



Figure B.1. Span Powering Unit Front Panel

## 2 GENERAL DESCRIPTION

he span power unit converts the power supplied by the AC line into a regulated DC current required power a T1 span line. The unit also provides a set of T1 pulse coupling transformers. These ansformers allows you to patch the 235A (or another test set) to the span line under power, ithout danger to you or to the test instrument.

he span power unit can supply a nominal current of either 60, 100, or 140 mA to a span line. The utput voltage is adjusted automatically to supply the selected current provided that the voltage equired does not exceed 270 VDC. Should a higher voltage be required, for example, if the span line open, the current source turns itself off and attempts to power the line again a few seconds later.

he current source is completely insulated from the AC line and from the chassis/power ground. It is quipped with short circuit protection. The SPU is also protected from foreign voltages which might ccidentally be applied to the output. Gas discharge protectors are connected across the span line to rovide lightning protection.

he span power unit contains digital measurement circuitry to measure the span line current and oltage.

## .3 FEATURES DESCRIPTION

he function of each of the features on four panel of the SPU are described in Tables B.1, B.2, B.3 nd B.4. The item numbers in these tables correspond to the circled numbers in the referenced gures.

.3.1 Front panel. Refer to Figure B.1

| Item | Name | Operation/Description |
|---|---|---|
| 1 | CURRENT (mA) | Selects the nominal span line current delivered by the current source. |
| 2 | SPAN MEASUREMENTS | Indicates the span current (in mA) or voltage (in Volts) as selected by item 3 below. |
| 3 | VOLTS/mA | Selects the measurement type displayed by the LED (item 2) above. |
| 4 | LED | As noted on the panel, this LED is lit when the SPU delivers a current to the span line. |
| 5 | TRANSMIT TO SPAN LINE | The three sets of jacks are connected in parallel and are designed to suit most common interfaces:<br>- A: a single 310 jack wired Tip/Ring, allows a single 310 cord with clips to be connected directly to the span cable pair.<br>- B: a pair of bantam jacks wired tip to tip |

Part of Table B.1 *(Continued)*

| Item | Name | Operation/Description |
|---|---|---|
| | | allows the use of standard dual plugs to protector cord sets.<br>- C: dual tip to tip jacks allow use of large dual plug to protector cord sets. |
| 6 | RECEIVE FROM SPAN LINE | This set of jacks is also connected in parallel; it complements the set of TRANSMIT jacks (item 5). |

Table B.1 Front Panel Features

B.3.2 Left hand side panel. Refer to Figure B.2

| Item | Name | Operation/Description |
|---|---|---|
| 1 | AC INLET | Must be connected to the AC power line. The AC line voltage must be in the range of 108-126 VRMS |
| 2 | FUSE | To ensure safety, if the fuse needs replacement, use only a 1 AMP slow blow 250VAC rated fuse. |
| 3 | POWER ON/OFF | AC power switch. |

Table B.2 Left Side Panel Features

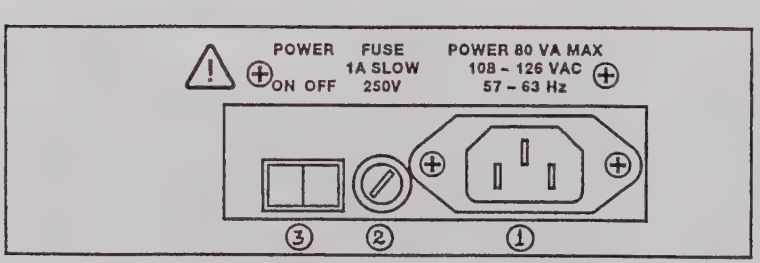



Figure B.2 Left Hand Side View

B.3.3 Near side panel. Refer to Figure B.3

| Item | Name | Operation/Description |
|---|---|---|
| 1 | FUSE | To ensure safety, if the fuse needs replacement, use only a 1/4 AMP fast blow 250VAC rated fuse. This fuse is in series with the span line. |

Table B.3 Near Side Panel Feature

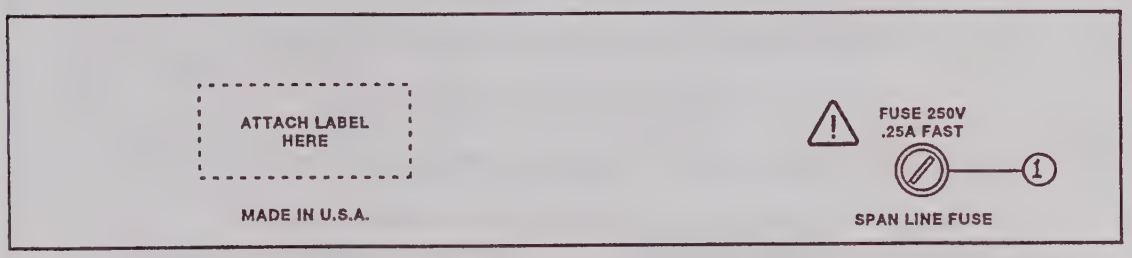



Figure B.3 Near Side Panel View

B.3.4 Right hand side panel. Refer to Figure B.4

| Item | Name | Operation/Description |
|---|---|---|
| 1 | RCV EQT | The tip and ring of this jack access the receive side of the span line. The circuit is insulated from the span line by a transformer. |
| 2 | XMT EQT | The tip and ring of this jack access the transmit side of the span line. The circuit is insulated from the span line by a transformer. |

Table B.4 Right Hand Side Panel Features

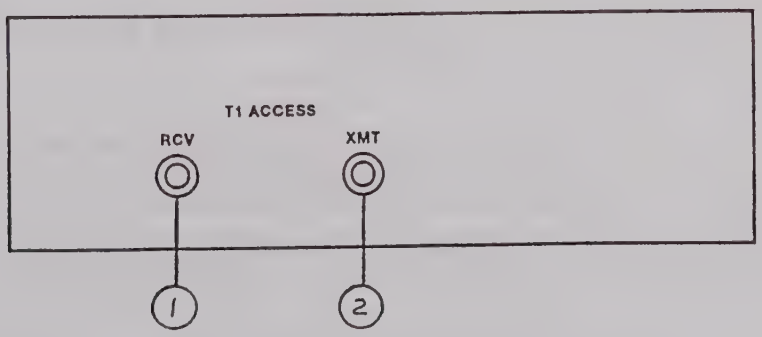



Figure B.4 Right Hand Side Panel View

## B.4 SAFETY CONSIDERATIONS

The span power unit includes several safety provisions designed to protect both the instrument and the operator. However, safety is also dependent upon the user's willingness to use safe practices when working with potentially dangerous voltages. To ensure the safe use of the span power unit, always follow the warnings and directions silkscreened on the unit front panel and reproduced below.

**WARNING**

**TO AVOID ELECTRIC SHOCK ALWAYS FOLLOW THESE INSTRUCTIONS:**

- Patch the unit to the span before powering the unit

- Turn off the unit before disconnecting from the span

- Do not use the unit when lightning threatens

- Do not operate the unit if water can enter the enclosure

- Do not operate the unit with the front panel removed

**DO NOT OPERATE THIS UNIT IN AN EXPLOSIVE ATMOSPHERE OR NEAR COMBUSTIBLE MATERIAL OR FUELS**

In addition, the following precautions should be observed as with most electronics test instruments:

- To avoid electrical shocks, the power protective grounding conductor must be connected to ground.
- Always disconnect the AC input from the power line before replacing fuses.
- Refer servicing of the unit to qualified personnel.

### B.4.1 SAFE START CIRCUIT OPERATION

To reduce the chance of injury resulting from accidental contact with the output jacks at power-up, the voltage presented to these jacks is controlled in the manner described below.

Case 1.
If the voltage required to maintain the selected current in the span line is less than 80 VDC, the voltage rises rapidly to the steady state voltage. Contact with this voltage causes an unpleasant shock but seldom any serious harm.

Case 2.
If the voltage required to maintain the selected current in the span line is greater than 80 VDC, the voltage rise rapidly to 80 V, and drops to 0V. It stays at 0V for about 2 1/2 seconds. This cycle is repeated three more times before the voltage is allowed to rise to the level required to sustain the selected current. Each voltage spike preceding the steady state condition has a nominal duration of 100 ms. Voltage spikes act as a warning.

Case 3.
If the voltage required to maintain the selected current in the span line is greater than 270

VDC, five voltage pulses are supplied by the span power unit. The first four pulses are as described in case 2. The fifth pulse reaches up to about 270 VDC and drops to 0V. Its duration is under 200 ms. This sequence of five pulses is repeated until the load resistance presented across the output terminals is reduced to allow the selected current to be reached with a voltage lower than 270 VDC.

## B.5 USING THE SPAN POWER UNIT

To power a span line (not otherwise powered by an office repeater), the span power unit is typically patched to the protector frame in the central office. The three combinations of jacks on the span line front panel accommodate the types of patch cables most commonly found in the office. Procedures are given below to power the span line, verify its proper powering, and de-powering the span line.

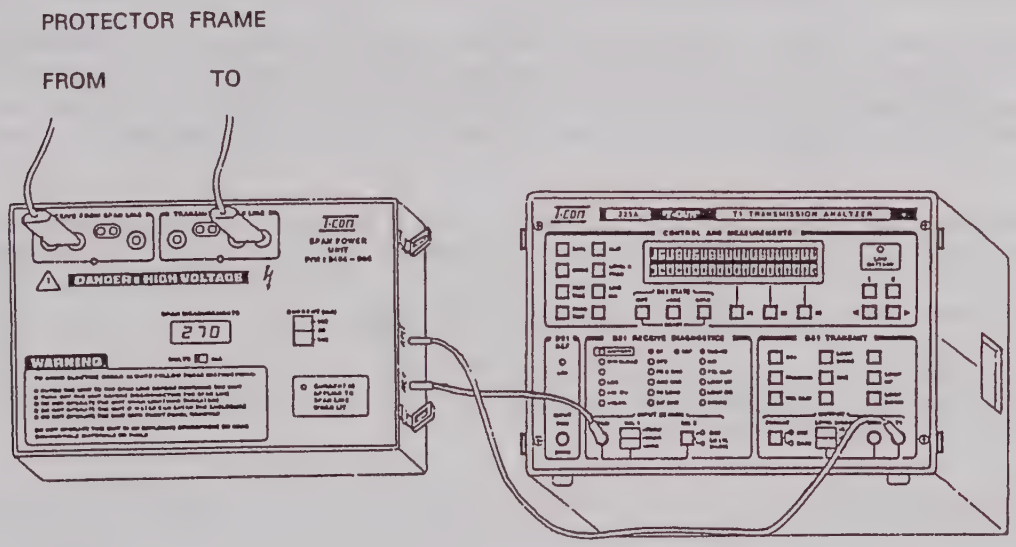



Figure B.5 Span Power Unit Set-Up

### B.5.1 Powering the span line

The following procedure must be carried-out in the order given to safely operate the span power unit.

1. Make certain that the span line is not already powered by an office repeater. This can be verified by measuring 0 VDC with one lead of a voltmeter connected to the transmit pair and the other lead connected to the receive pair of the span line.
2. Verify that the Span Power Unit power switch is OFF.
3. Connect the SPU equipment input and output jacks to the DS1 test set. (Items 1 and 2 in Figure B.4.)
4. Using the proper cables, connect the line jacks to the span line as illustrated Figure B.5. Make sure that the TRANSMIT and RECEIVE jacks are patched to the transmit and receive pairs respectively. (If the connections are reversed, the span line will not be powered.)
5. Connect the power cord to the SPU and to an active AC line outlet.
6. Select the span line current as required.

7. Keep your hands away from the TRANSMIT and RECEIVE jacks as well as from the cables and set the SPU power switch to ON. At this point, the SPU initiates the power-on cycle as described in the previous section.

### B.5.2 VERIFYING THE SPAN LINE POWERING

You can identify several possible span line problems by comparing the span line voltage measurement with the engineering requirements.

Span line voltage and current measurements are valid only when the SPU operates in the steady state mode. This mode is indicated by the solidly lit LED on the front panel. The voltage and current measurements are displayed directly by the three 7-segment LEDs; you only need to select the measurements with the VOLT/mA slide switch. The current reading is useful for ensuring that the SPU operates properly. This is the case when the reading is within 1% of the selected current value.

If the voltage reading is significantly lower than expected, the cause can be traced to either a short between the transmit and the receive pairs somewhere along the line, or to a mis-optioned repeater. For example, if a repeater is strapped for the LOOP mode when in fact it should have been strapped for the THRU mode, the SPU is called to supply less power. This translates into a lower voltage reading.

If the voltage reading is significantly higher than expected, the cause is typically traced to an open connection in one of the two leads in either the transmit or the receive pair. A higher wire gauge than specified can also yield higher voltage readings. A line repeater optioned for THRU while it should have been optioned for LOOP will have the same results.

If the voltage reading is unstable and varies by several volts over a few seconds while the LED is solidly lit, the cause can likely be traced to a bad contact in one of the leads in the span line. It is also possible that a repeater is malfunctioning.

### B.5.3 DE-POWERING THE SPAN LINE

To remove power from the span line, proceed as follow:

1. Turn off power on the SPU by setting the AC switch to OFF
2. Wait a few seconds to let the SPU output capacitor discharge fully.
3. Disconnect the span powering cables from the SPU.

## B.6 SPU INTERFACE CIRCUIT DIAGRAM

The SPU interface circuit with the span line is given in Figure B.6. This diagram shows that you can patch the SPU to the span line using different combinations of cables.

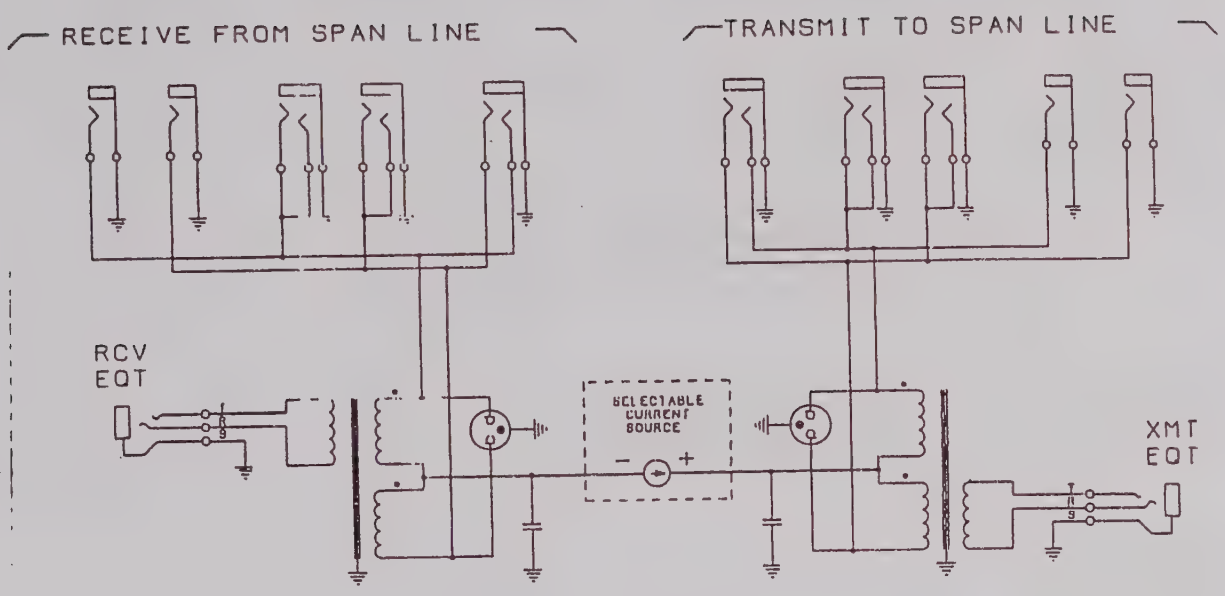



Figure B.6 SPU To Span Line Interface Circuit Diagram

[space left intentionally blank]

## B.7 SPU specifications

This section contains the specifications applicable to the span power unit only.

| | | |
|---|---|---|
| **Current source:** | | |
| - Current selection | : | 60mA, 100mA, and 140mA nominal |
| - Current accuracy | : | +/- 2% |
| - Compliance voltage | : | 12 to 270VDC |
| **Protections** | : | Against short circuit (any duration) |
| | : | Overvoltage in excess of 270V +/- 10V |
| | : | Three terminal 350V surge arrester |
| | : | 1000 VDC insulation to chassis/ground |
| **Interfaces** | | |
| - With T1 equipment | : | Bantam jacks (XMT and RCV) |
| - With span line | : | Dual 310 jacks (tip-to-tip) |
| (for XMT & RCV) | : | Dual bantam jacks (tip to tip) |
| | : | Single 310 jack (tip to ring) |
| **Measurements:** | | |
| - Voltage range | : | 0 to 300VDC |
| - Voltage accuracy | : | +/- 1% |
| - Current range | : | 0 to 200mA |
| - Current accuracy | : | +/- 1% |
| **LED indicator** | : | Lit when current is supplied by the SPU to a load (or span line) |
| **Pulse transformers:** | | |
| - Coupling loss | : | .5 dB maximum at 772 KHz in 100 Ohm load |
| - Hi-pot insulation | : | 1000 VDC minimum |
| **Miscellaneous:** | | |
| - Power requirement | : | 108 to 126 VAC, 57 to 63 Hz, 80 VA max |
| - Hi-pot insulation | : | 1000 VDC minimum from AC input to chassis |
| - Operating temp | : | -10 to 45°C |
| - Storage temp | : | -30 to +65°C |
| - Humidity | : | Up to 90% non-condensing |
| - Dimensions | : | 6.5" x 9.6" x 2" (for 235A only) |
| | : | 8.1" x 9.6" x 2" (for 235A with 54B) |
| - Weight | : | 3.0 lbs nominal |

The SPU fully complies with UL 1244 safety standards for labels and warnings.

2 T 1